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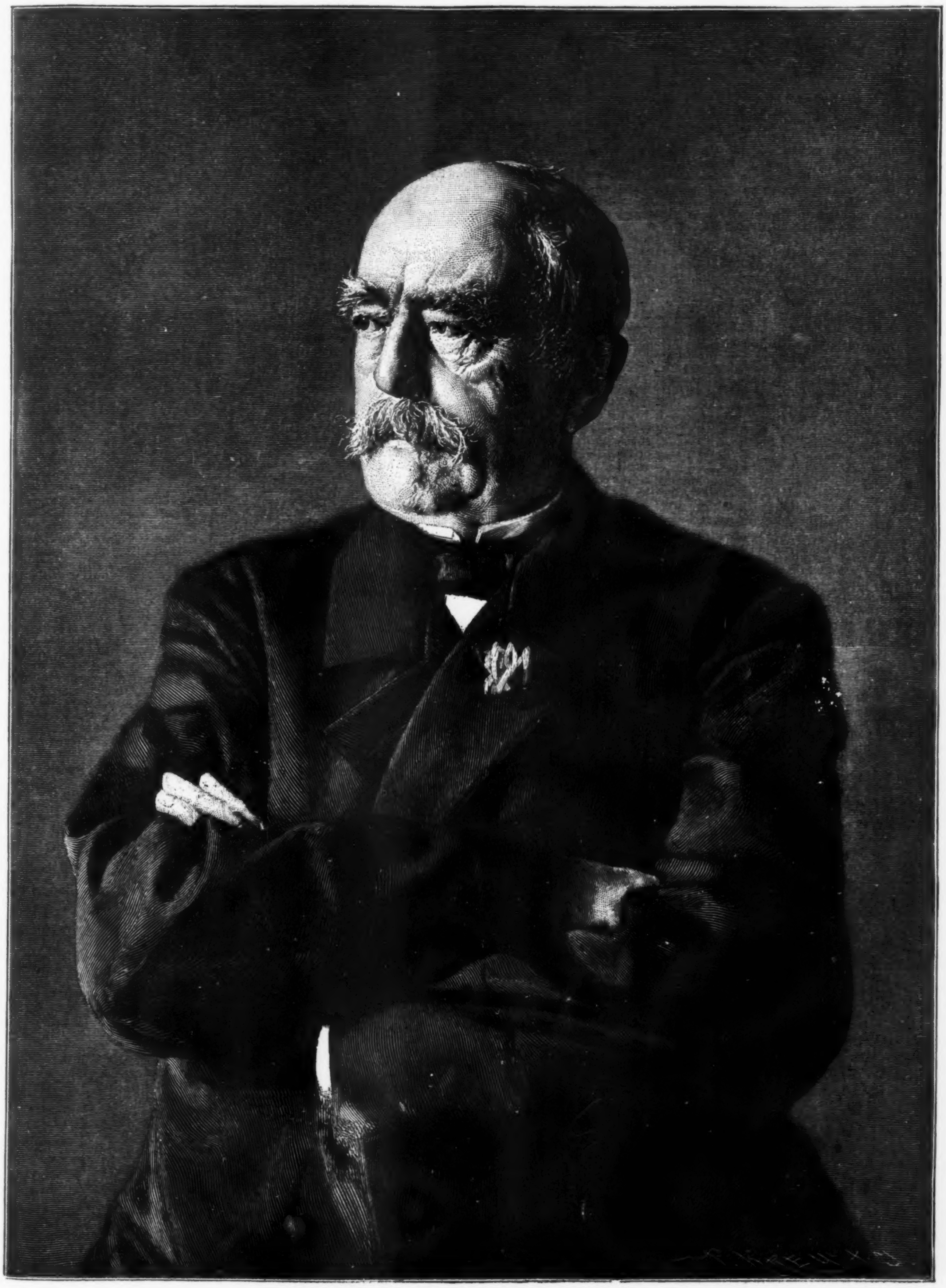


BISMARCK.

(From the Illustrirte Zeitung, Berlin.)

BISMARCK.

IT is often said that a great man is never fully appreciated until some time after his death, but the enthusiastic receptions tendered to Bismarck wherever he goes, as well as the tone of the press in Germany and elsewhere, indicate that this rule does not hold good in the case of the great statesman.

Otto Eduard Leopold Bismarck-Schonhausen belongs to a family that can be traced back for upward of five centuries. Some of his ancestors lived in the little town of Bismarck (first written Biscopesmarck or Bishopsmark), and, according to some authorities, when surnames became necessary, they followed the custom of the time and called themselves, from the town they lived in, Von Bismarck.

Otto von Bismarck was born at the manor of Schonhausen, in the district of Magdeburg, April 1, 1815. His father, Karl Wilhelm Ferdinand von Bismarck, was captain of the royal body guard of Prussia, and his mother was a daughter of Cabinet Councilor Menken. He was educated at Gottingen and Berlin, and was admitted to the bar in 1835. In 1847 he married Johanna von Putkammer, and in the same year was sent to the united diet or parliament at Berlin. His ultra-royalist principles made him an important aid to the King of Prussia, who had already begun to appreciate his extraordinary ability, and who, it is stated, was on the point of abdicating.

In 1851 he was sent to Frankfort as first secretary of legation, and was afterward appointed Prussian Ambassador to the Germanic Diet at Frankfort. His aim from the first was the union of Germany, with Prussia as the leading power; a project to which, of course, Austria would never willingly consent. He declared that Prussia would never fulfill her mission until Austria was driven from the Bund, and he repelled the pretensions of that empire with so much bitterness that it was thought prudent to transfer him to St. Petersburg, where he greatly strengthened the relations between Russia and Prussia.

In 1862 he was sent on a mission to Paris, and in the autumn of the same year he was appointed prime minister and minister of foreign affairs. During the exciting conflict between the government and the diet he was vehemently opposed by the liberals, and he dissolved the chamber, declaring that the ministry would enforce its measures without the assistance of the deputies. He was extremely unpopular with the party of progress and the friends of constitutional government, but there was one common ground on which they met—the desire for German unity—and this had caused him to change his tone toward Austria. In spite of her unfriendly attitude, he succeeded in obtaining her co-operation in the Schleswig-Holstein war. He concluded a commercial treaty with Austria in 1865, and the Gastein convention ended, for the time, the Schleswig-Holstein complications. On September 20, 1865, Bismarck was promoted to the rank of count, and invested with ministerial authority over the newly acquired territories. But the relations between Austria and Prussia became more and more strained, and a majority in the German Bund having voted for Austria, Prussia withdrew from the Bund and formed an alliance with the King of Italy. In June, 1866, war was declared against Austria and her allies, who were defeated at the decisive battle of Sadowa, July 3, 1866, and, by the treaty of Prague, August 23, Austria's existence as a German power was terminated.

Bismarck, who was so unpopular before the war that an attempt was made on his life, now became the idol of the Prussian people, and a national endowment was conferred on him by the chambers. But all of this aroused the jealousy of Napoleon, and the appearance of a new military power alarmed the French. The cry "Revenge for Sadowa!" was heard in the streets of Paris, and in 1870 Napoleon found a pretext for declaring war against Prussia. His attempts to form an alliance with Austria were baffled by Bismarck's secret treaties with the South German States and his understanding with Austria, and the declaration of war was met with such an unprecedented spirit both by the North German Confederation and the South German States that the result was utterly disastrous to France, and King William was proclaimed Emperor of Germany at Versailles, January 18, 1871. Soon after this event Count Bismarck was made prince and given the title of Chancellor of the German Empire.

He enjoyed the entire confidence of his sovereign during the life of Emperor William I., who was noted for his wisdom in the selection of his ministers and the firm support he gave them against all opposition. But the Crown Prince had never been in sympathy with Bismarck's policy, and after his accession to the throne as Frederick I., the proposition of a marriage between his oldest daughter, the Princess Victoria, and Alexander of Battenburg, ex-Prince of Bulgaria, brought about the "chancellor crisis. The project was sacrificed, however, to state reasons, and Bismarck continued in office. On the occasion of the retirement of Von Puttkamer, the chancellor also expressed his surprise and regret in a very ostentatious manner.

When, at the end of this short reign of three months, William II. came to the throne, it seemed as if the relations between the Iron Chancellor and the new monarch might be more harmonious, but it soon became evident that the latter preferred the advice of Dr. Hinzpeter, his former tutor, and Count Waldersee. The chancellor's display of temper in connection with the publication of parts of the diary of Emperor Frederick is said to have displeased William, although he followed the prince's advice and instituted criminal proceedings against Prof. Geffcken. The conservative policy of the chancellor did not meet with the approval of the young emperor, who desired to combine the monarchical traditions of the Hohenzollerns with advanced modern ideas. His consulting with the other ministers, instead of leaving all to the control of his prime minister, his publication of rescripts without the indorsement of Bismarck, etc., showed his determination to be his own chancellor, and made Bismarck's continuance in office impossible. He prepared the public for his early retirement by expressing a desire to resign the presidency of the Prussian ministry, but the opposition which he constantly encountered made it clear to him that it was necessary to lay down his three offices at once, which he did March 18, 1890. In his letter of acceptance the emperor expressed regret and disappointment, but he withheld from the public the document in which the chancellor set forth his reasons for resigning. The emperor made him a field marshal, gave him the title of Duke of Lauenburg, and requested him to accept the continuation of his official emoluments and the use of the official residence in Berlin. These last he rejected, as he did also the title of duke, but the military promotion he accepted in deference to the principle of army discipline. After his resignation his son, Count Herbert, was made provisional president of the Prussian ministry and minister of foreign affairs, but both he and his brother insisted upon resigning with their father.

Bismarck continued to express his opinions in regard to foreign affairs so freely that the new chancellor, Georg von Caprivi, considered it best to send a confidential circular to the representatives of Germany abroad, stating that Bismarck's utterances did not reflect the views of the government. But the prince would not allow the public to think that his advice was sought or tendered, for he hastened to deny, through his press organs, that any attempt had been made to dissuade him from his decision to resign, and did not hesitate to show his wrath that he should have been placed in such a position. It is said that efforts were made to keep all interviewers away from Friedrichsruhe, his winter residence, and that William even threatened to visit upon him the consequences of his displeasure if he persisted in his hostile attitude; but nothing daunted, the ex-chancellor continued to express his views, never condescending to dissemble his feelings or to adopt a conciliatory tone. In all this his iron will is shown, and it does not seem strange that such a man, at the end of such a life, should exclaim fiercely, "They are breaking off bits of the edifice to the erection of which I have devoted my life."

The offerings sent him on his seventy-seventh birthday, the first day of last April, show plainly that he is still held in the highest esteem, and we have still stronger evidence of this in the ovations that he received on the occasion of his journey to Vienna in July of this year, to attend the marriage of Count Herbert to the Countess Marguerite Hoyos. This visit caused a great commotion in diplomatic circles, the German and Austrian Emperors and the Czar all giving special instructions to their ambassadors for the government of their conduct during the presence of the prince in Vienna. The Austrian officers of state were absent, and only the Russian ambassador attended the wedding. The Emperor Francis Joseph refused to give Bismarck an audience, a slight that he bitterly resented. The people, however, were very demonstrative, many deputations visiting Vienna, others tendering him invitations to visit their towns, and wherever he stopped during the journey he was received with the greatest enthusiasm. He made many speeches, and in one of these, addressed to a deputation from the municipality of Dresden, he said, "I represent the past, which has vanished, and will never again enter public life." This is especially interesting in view of the fact that he is now a member of the Reichstag, and although he has never occupied his seat since his election, many have thought that he would do so.

This stern statesman is said to be a most genial, pleasant gentleman in private life, even jovial and tender-hearted, but the instant that the affairs of state are touched, he hardens. M. Thiers said of him in connection with his founding of the German empire, "In considering the event, I am tempted to exclaim with Bossuet, 'A man was found!' Not that I wish to institute any comparison between Cromwell, to whom the quotation applies, and the bold minister who has so rapidly raised Prussia to greatness; . . . but, considering how wonderfully adapted he has shown himself to the task he has undertaken, I cannot help saying, 'Yea, a man was found endowed with rare political sagacity, still greater boldness, and whom his countrymen must consider a great patriot.'"

For the accompanying portrait we are indebted to the *Illustrirte Zeitung.*

[Continued from SUPPLEMENT, No. 870, page 13903.]

THE LIFE OF DR. P. H. VANDER WEYDE.

AN AUTOBIOGRAPHY.

III.

THE principal inducement leading to the leveling and abolishment of the walls and defensive earthworks surrounding the city of Nymegen, described before, was the great change which had taken place in military strategy since the beginning of the nineteenth century. At that time strongly fortified cities were considered the principal safeguards for protecting any country against foreign invasion, because the first task of an invading army was considered to be the beleaguering and conquest of the fortified cities on the frontier before proceeding in the interior, as it was supposed to be unsafe to leave any unvanquished enemy in the rear.

The strategy of the first Napoleon, in the beginning of this century, did, however, upset these notions. For instance, when he invaded Germany, he did not detain nor weaken his troops by detachments for the conquest of fortified cities, but marched by them with his large army, which lived by levying and confiscating the necessities of life from the magazines or the inhabitants, and marched directly to the capitals, say Berlin and Vienna, delivering battles in the field and defeating the opposing armies by the concentration of his strength, directed by his strategy, and accomplished by the bravery and enthusiasm of his soldiers, and finally prescribed his terms of peace at the seat of the foreign government. At the late Franco-Prussian war Prussia acted in a similar way when the conditions of peace were prescribed by her after entering Paris.

The strategy of Napoleon worked wonders as long as he applied it to densely populated countries, such as Germany, Austria, Italy, etc., but when he applied it to a vast country with a sparse population, such as Russia, it was a complete failure, especially by the peculiar strategy adopted by the Russians, which was never to deliver battle, but constantly retreat, and carrying off or destroying everything that might be of benefit to the invaders.

There is in the whole field of history no other record of a national defense of such a nature, and, as is universally known, it destroyed by fatigue, in continual marching and privation of food, more of Napoleon's men than could have been killed in pitched battles, and at less expense in money and lives for Russia. It was the prelude to the downfall of the Napoleonic empire.

My father and mother often gave me graphic accounts of their experience in caring for soldiers, which, as is the European custom, are, in times of an enormous influx, quartered among the inhabitants. The local governments are provided with records, which show how many soldiers each house can accommodate, while afterward the government pays to such inhabitants a fixed compensation for food and lodging.

As Nymegen lies on one of the great highways to and from the east, thousands of soldiers passed there, in their march forward or returning. As it is an exemplary healthy city, it will always be a favorite place for a large garrison, for which numerous barracks form convenient lodgings, while large military and civil hospitals offer great opportunities for medical treatment, by which circumstances several of the Nymegen physicians have attained a high reputation, and administer to patients from all parts of Holland who find no relief at home.

As my parents lived in a large house, they had a liberal share of the patronage of those who were charged with distributing the soldiers for whom there was no room otherwise. In this way they obtained experience in regard to the characters of different nationalities, and their communications to me in this respect were instructive and interesting in the highest degree. They always testified that the most polite, most accommodating and always satisfied soldiers were the French, which they preferred above all other nations.

This friendly feeling between Holland and France, which is reciprocal, is the key to the following remarkable event.

The French entered Holland in 1795 by request of a large number of the most respected citizens, for the purpose of making an end to the rioting and plundering which was taking place since 1787 in some cities by the lower classes, and which the then existing general government had not the power to suppress, while the locally elected municipal governments were in such cities intimidated by the mob, and had disbanded the national guard, making them surrender their arms. These disorders came at once to an end at the arrival of the French army, which kept the mob under control, made the peaceful election of local authorities by the citizens possible, and gave their protection to the local government thus elected. This government at once re-established and returned the arms to the old national guard, which my father then joined, so as to do service for the welfare of old Netherlands. Like my oldest son Henri did in New Netherlands, when sixty-five years later he joined the 7th regiment of the New York National Guard; first for the protection of Washington, and further to do service with the 65th Regiment of New York Volunteers during the whole course of the great civil war, while at last he left the army with the rank of brevet major.

He did better than his grandfather, but in justice to the latter it must be considered that he had never the opportunity to fight as much as the grandson, who took part in twenty-three of the many battles taking place through our great civil war. I am sure father would have done as well if only the old man had been given a chance, as already in boyhood he showed an almost reckless courage.

For instance, in order to satisfy his curiosity to see how fortified cities were taken by an attacking army, he succeeded, as soon as it was rumored that an attack was to be made, he hid himself outside the earthen breastwork on the top of the stone wall of Nymegen. This breastwork was mounted with barbette guns. At once such a gun commenced firing just over him, and at every shot covered him with earth, but he had to endure it until the enemy retreated from there and joined the attack made on another point. In commemoration of such attacks there are several houses in which the large cannon balls have been inserted half way in the walls, at the spot where they were struck.

These are some of the minor curiosities of that town.

During my boyhood the city authorities opened to public inspection a collection of antiquities found in the neighborhood, and which had slowly been accumulated in a private room in the city hall. A long gallery was set apart for this purpose, where could be seen, for instance, a bass-relief of Julius Cæsar, with his wreath of laurels, and placed between two horse heads; several stones with Latin inscriptions, statues and remnants of statues; the sword with which the Counts of Egmont and Hoorn were beheaded, the iron rings and hooks with which the dismembered parts of the body of Martin Schenk (a patriot who tried, but failed, to capture the city from the Spaniards in 1589) had been suspended at the city gates while his head was put on a spike in the public market. Then the complete set of town charters which the city obtained from the time of Henry IV., in the year 1230. The latter are, however, not open for public inspection, but hidden in a strong iron safe which, when necessary, is only opened with the utmost precautions, such as locking all the doors and gates, and surrounding the city hall with the military garrison.

This city hall has in front, between the windows, statues and medallions of Roman emperors, which have escaped the destructive work of the iconoclasts or image destroyers, so vigorously at work during the great reformation. The twelve statues in front of what was in my boyhood used for the Latin school, formerly a monastery, were not so fortunate. I saw them daily when I went to the class, and regretted that often they had, every one of them, their heads knocked off. They were the statues of the twelve apostles; and even that of Christ over the entrance, where he was represented as sitting on clouds and judging the world, did not escape the ordeal intended for all statues of saints, for which the people used to kneel and adore them. The statues in front of the city hall escaped destruction, because they represented no saints.

THE art of paper-making has reached that point where a growing tree can be cut down and converted into a newspaper, within twenty-four hours.

EUGENE H. COWLES.

Eugene H. Cowles, of Lockport, N. Y., the president of the Cowles Electric Smelting and Aluminum Company, and the inventor, in connection with his brother, of the Cowles process of electric smelting, as well as the original inventor of the overhead conduction system of electric railroads, died of consumption in El Paso, Tex., on the 21st of April, 1892. Mr. Cowles was born in Cleveland, O., in 1855, where his father, the late Edwin Cowles, was the editor and proprietor of the *Leader*. At the age of nineteen Mr. Cowles made his first effort as a writer. The success met with by this venture was such that he was offered a place on the *Leader* by his father, and during the next seven years he at one time or another filled every position on the paper, from reporter to that of managing editor.

Naturally of a scientific and inventive turn of mind, while in Washington he spent much time in the Patent Office and various scientific bureaus of the government, especially in the study of metallurgy in the Patent Office. At this time the subject of making steel castings had been brought to his attention by a relative who was perfecting a process for casting mild steel.

These studies in metallurgy and electricity and the constant work of writing descriptions of new inventions and engineering subjects had so interested him in technical work that in 1881 he resigned his position on the *Leader* and undertook the organization of the Brush Electric Light and Power Company, of Cleveland, and in the course of sixty days he raised the necessary capital, $150,000, and launched out for the first time in a technical pursuit as secretary and manager of the new company.

It was while connected with the electric lighting company that Mr. Cowles applied for the first patent granted anywhere in the world, it is said, for a system of electric railways which could be operated by electricity conducted to a moving car from a station by an *overhead* conductor.

In the early winter of 1882, just as Mr. Cowles had perfected plans to apply this system of electric propulsion to a street railroad running out of the suburb of Cleveland called Glenville, he was taken down with acute pneumonia, and was forced to drop all business and go to Colorado for his health. From the effects of this attack he never recovered, and it was this trouble which eventually carried him off.

After four months of convalescence at Colorado Springs, Cowles took up mining as a pursuit to engage his mind. With this in view he, in company with E. W. Nelson, the Siberian and Alaskan explorer, laid out a systematic tour of inspection of the mining camps of Colorado, New Mexico and Arizona. The result of two years of this sort of work was that Cowles and his younger brother, Alfred H. Cowles, together with his father, became interested in a mine on the Pecos River, whose ore, like Pandora's box, contained a little of everything that was evil. It was in an apparently hopeless effort to devise some scheme to work these ores that the idea of applying electrical heat to the reduction of ores, which had long been in Mr. Cowles' mind, was taken up, and he and his brother set earnestly to work to reduce it to practice.

The two brothers thereupon returned to Cleveland in the summer of 1884 and began an exhaustive series of experiments on the electrolysis and in the electric smelting of ores. Concomitant with these experiments an expensive and extensive research was made under their direction through the patent offices and great scientific libraries of the world for information as to the exact amount of work that had been done and thought which had been recorded on the use of electricity in the reduction of metals from their ores and compounds.

The result of this study of literature of the subject was most discouraging so far as giving the would-be inventors any light or assistance in the use of the current as proposed. There was not a single proposition to be found anywhere for application of internal electrical heat for the reduction of ores. The idea of doing this did not even appear to have been suggested, and of course there were no experiments recorded on the subject. It was true that from the day that the electric arc was first produced people had inserted all manner of substances into it out of idle curiosity to see them burn or become disassociated, and Sir Humphry Davy had taken advantage of this phenomenon in certain laboratory experiments on the alkaline salts.

In the absence of any data on the subject at that time, buoyed up by the faith that the virginity of the field of work into which they had entered was such that whatever patents they obtained would be completely novel, the Messrs. Cowles proceeded with their experiments with redoubled vigor. A partnership was formed under the name of Eugene H. Cowles & Co., money was raised, patents were applied for, and the experiments repeated without number. These embraced scores of forms of electrical furnaces, apparatus for operating the same, the trying of special forms of dynamos, production of peculiar carbons, preparing of various ores, production and investigation of the physical properties of alloys, etc.

It was discovered that by the electrical process every common metal that could be reduced by heat and carbon alone could also be reduced by the electrical furnace, while many of the rarer elements, like aluminum, silicon, boron, potassium, sodium and phosphorus, were also obtainable by the use of the electrical heat and energy. On many occasions it has been asserted that the operation of the Cowles' electrical furnace is simply that of the combined action of heat and carbon. Mr. Cowles asserted that there was nothing in the Cowles process, specifications or patent claims to justify any such limitation. The process combined heating and electrolytic action. It also covered both the principle of incandescent and arc heating action when applied to the reduction of ores.

In 1885 the partnership of Eugene H. Cowles & Company was converted into the stock company called the Cowles Electric Smelting and Aluminum Company. The first company ever organized for this purpose has since been the owner of all the patents taken out in America and in Europe, with the exception of the English patents, which are owned and operated by the Cowles Syndicate Company first, with works at Milton, near Stoke-on-Trent. When this company was first organized, aluminum in its pure state could only be had at about $16 per pound, and it is now to be had at 50 cents per pound, f. o. b. in Lockport in ton lots, and that of the highest purity.

THE LATE EUGENE H. COWLES.

Mr. Cowles was a frequent contributor to various scientific societies, and was a member of the American Institute of Mining Engineers, the Naval Institute of Annapolis, the Franklin Institute of Philadelphia, the American Association for the Advancement of Science and the Royal Institution of Great Britain. He, together with his brother, was the recipient of the Elliot Cresson gold medal, awarded by the Franklin Institute, the John Scott Legacy medal from the city of Philadelphia, and a gold medal from the Paris Exposition of 1889, for improvements in the production of aluminum and the application of electricity to the reduction of ores.—*Engineering and Mining Journal.*

BREATH FIGURES.

By W. B. Croft, M.A., Winchester College.*

Fifty years back Prof. Karsten, of Berlin, placed a coin upon glass, and by electrifying it made a latent impression, which revealed itself when breathed upon. About the same time Mr. W. R. (now Sir W. R.) Grove made similar impressions with simple paper devices, and fixed them so as to be always visible. A discussion of Karsten's results occurs in several places, but I have not been able to find details of his method of performing the experiment. During my attempts to repeat it some effects have appeared which seem to be new and worthy of record.

After many trials I found the following method the most successful: A glass plate, 6 inches square, is put on the table for insulation; in the middle lies a coin with a strip of tinfoil going from it to the edge of the glass; on this coin lies the glass to be impressed, 4 or 5 inches square, and above it a second coin. It is essential to polish the glass scrupulously clean and dry with a leather; the coins may be used just as they usually are, or chemically cleansed, it makes no difference. The tinfoil and the upper coin are connected to the poles of a Wimshurst machine which gives 3 or 4 inch sparks. The handle is turned for two minutes, during which one inch sparks must be kept passing at the poles of the machine. On taking up the glass one can detect no change with the eye or the microscope; but when either side is breathed upon, a clear frosted picture appears of that side of the coin which had faced it; even a sculptor's mark beneath the head may be read. For convenience those parts where the breath seems to adhere will be called white, the other parts black. In this experiment the more projecting parts of the coin have a black counterpart, but there is a fine gradation of shade to correspond with the depth of cutting in the device; the soft undulations of the head and neck are delicately reproduced.

The microscope shows that moisture is really deposited over the whole surface, the size of the minute water granulation increasing as the point of the picture is darker in shade.

There seems to be no change produced by the use of coins of different metals.

If sparking is allowed across the glass instead of at the poles of the machine, traces of metal are sometimes deposited beyond the disk of the coin, but not within it.

Around the disk is a black ring ¼ inch broad; sometimes the milling of the coin causes radial lines across this halo.

If carefully protected, there appears to be no limit to the permanence of the figures, but commonly they are gradually obscured by the dust gathered up after being often breathed upon; some of the early ones, done more than two years back, are still clear and well defined in the detail.

It is possible to efface them with some difficulty by rubbing with a leather while the glass is moist. They are best preserved by laying several together when dry and wrapping them in paper; they are not blurred by this contact.

It is a curious fact that certain developments take place after a lapse of some weeks or months. The dark ring around the disk gradually changes into a series of three or four, black and white, alternately; other instances of such a change will be noted below.

Let it be noticed that in coin pictures the object is near to, but not in contact with, the glass; for in the best specimens the rim of the coin keeps the inner part clear of the surface.

Obviously a small condenser is made by the coins; it is not essential; at the same time images made by a single coin, put to a single pole, are inferior.

The plan which gives the surest and most beautiful results is to place five or six coins, lying in contact side by side in a cross or star, on either side of the glass; it is not necessary that each coin should exactly face one on the other side.

There has not appeared any distinction between the figures made by positive and negative electricity.

When several coins are side by side, touching one another, there appear in the spaces between them, which are mostly black, well defined white lines, common tangents to the circular edges of the coins. If these are of equal size, the lines are straight; otherwise they are curved, concave toward a smaller coin. They seem to be traces in that plane of the loci of intersection of equipotential surfaces.

Similar effects are obtained when coins and glasses are piled up alternately, and the outer coins are put to the poles of the machine. With six glasses and seven coins perfect images have been formed on both sides of each glass. With eight glasses the figures were imperfect; but there is little doubt this could be improved by continued trials as to the amount of electricity applied.

If several glasses are superposed and coins are applied to the outer surfaces, there are only the two images at the outside. After the electrification there is a strong cohesion between the plates.

It requires some practice to manage the electrification so as to produce the best results. There are two forms of failure which present interesting features. Sometimes a picture comes out with the outlines dotted instead of being continuous. At other times, if the electrification is carried too far, the impression comes out wholly black; but on rubbing the glass when dry with a leather the excess is somehow removed. Naturally, it is difficult to rub down exactly to the right point, but I have succeeded on several occasions in developing from a blank all the fine detail of elaborate coins.

Here again we have another instance of the development by lapse of time, for an over-excited piece of glass usually gives a clear picture after an interval of a day or two.

Impressions from stereotype plates have been taken of which the greater part is legible; the distinctness usually improves after a few days. In default of a second plate, a piece of tinfoil about the same size should be put on the opposite side of the glass.

Sheet and plate glass of various thicknesses have been used without any noticeable change either in the treatment or the results.

I have put an impressed glass on a photographic plate in the dark, but did not get any result on developing; my imperfect skill in photographic matters leaves this experiment inconclusive.

Probably all polished surfaces may be similarly affected; a plate of quartz gives the most perfect images, which retain their freshness longer than those on glass.

Mica and gelatine give poorer results; it is not possible to polish the surface to the necessary point without scratching it.

On metal surfaces fairly good impressions can be produced if, as Karsten advises, oiled paper is put between the coin and the surface.

In the order of orignal discovery the figures noticed by Peter Riess should come first. He discusses a breath track made on glass by a feeble electrical discharge; as well as two permanent marks, noticed by Eitrick, which betray a disintegration of the surface.

I have found that when a stronger discharge is employed more complex phenomena of a similar kind are produced. A 6 in. Wimshurst machine is arranged with extra condensers, as if to pierce a piece of glass. If this is about 4 in. square, the spark will generally go round it. For a day, more or less, there is only a bleared, watery track, three-tenths of an inch wide, when the glass is breathed upon; but after this time others develop themselves within the first, a fine central black line with two white and two black on either side, the total breadth being the original three-tenths of an inch. These breath lines do not precisely coincide in position with the permanent scars, but the central one is almost the same as a permanent mark, which the

* Communicated by the Physical Society: read June 24, 1892.

microscope shows to be the surface of glass fractured into small squares of considerable regularity; on either side is a gray blue line always visible, which Riess ascribes to the separation of the potash. After several months I found two blue lines on either side, which I believe were not visible at first. Of course these blue lines may be seen on most Leyden jars, where they have discharged themselves across the glass.

In 1842 Moser, of Konigsberg, produced figures on polished surfaces by placing bodies with unequal surfaces near to them; the action was ascribed to the power of light, and his results were compared with those of Daguerre. Moser says: "We cannot therefore doubt that light acts uniformly on all bodies, and that, moreover, all bodies will depict themselves on others, and it only depends on extraneous circumstances whether or not the images become visible." In general, the multitude of images would make confusion; it can only be freshly polished surfaces that are free to reveal single definite impressions. However great Moser's assumption may be, there are many achievements of modern photography that would be as surprising if they were not so familiar. I have not the means of knowing the precise form of Moser's methods: in the experiments which follow there is usually contact and light pressure, and if they are not wholly analogous, they may for that cause help to generalize the idea: in none of these is electricity applied.

A piece of mica is freshly split, and a coin lightly pressed for 30 seconds on the new surface: a breath image of the coin is left behind. At the same time it may be noticed that the breath causes abundant iridescence over the surface, while it is in a fresh state. It is not clear how the electricity of cleavage can have an active agency in the result.

It is familiar to most people that a coin resting for a while on glass will give an outline of the disk, and sometimes faint traces of the inner detail when breathed upon.

An examination paper, printed on one side, is put between two plates of glass and left for ten hours, either in the dark or the daylight; a small weight will keep the paper in continuous contact, but this is not necessary if thick glass is used. A perfect breath impression of the print is made, not only on the glass which lay against the print, but also on that which faced the blank side of the paper. Of course the latter reads directly, and the former inversely; the print was about one year old, and presumably dry.

More often both impressions are white, sometimes one or other or both are black. At other times the same one may be part white and part black, and they even change while being examined.

During a sharp frost with east winds early in March, 1890, these impressions of all kinds were easy to produce, so as to be quite perfect to the last comma; but in general they are difficult, more especially those from the blank side.

At the best period those from the blank side of the paper were white and very strong; also there were white spots and blotches revealed by the breath. They seemed to correspond with slight variations in the structure of the paper, and suggest an idea that the thickness of the ink or paper makes a minute mechanical indentation on the molecules; the state of these is probably tender and sensitive under certain atmospheric conditions, as happens with steel in times of frost.

The following experiments easily succeed at any time: Stars and crosses of paper are placed for a few hours beneath a plate of glass: clear white breath figures of the device will appear. A piece of paper is folded several times each way into small squares, then spread out and placed under glass; the raised lines of the folds produce white breath traces, and a letter weight that was above leaves a latent mark of its circular rim.

Some writing is made on paper with ordinary ink and well dried; it will leave a very lasting white breath image after a few hours' contact. If, with an ivory point, the writing is traced with slight pressure on glass, a black breath image is made at once. Of course this reads directly and the white one inversely. It is convenient to look through the glass from the other side for inverse impressions, so as to make them read direct.

Plates of glass lie for a few hours on a table cover worked with sunflowers in silk: they acquire strong white figures from the silk.

In most cases I have warmed the glass, primarily for the sake of cleansing it from moisture; but I have often gone to a heat beyond what this needs, and think that the sensitiveness has been increased thereby.

It is not easy to imagine what leads to the distinction between black and white, different substances act variously in this respect. I have placed various threads for a few hours under a piece of glass, which lay on them with light pressure: wool gives black, silk white, cotton black, copper white. A twist of tinsel and wool gives a line dotted white and black; after a time these traces show signs of developing into multiple lines, as in the spark figures.

Two cases have been reported to me where blinds with embossed letters have left a latent image on the window near which they lay; it was revealed in misty weather, and had not been removed by washing. I have not had a chance to see these for myself, but both my informants were accustomed to scientific observation.

A glass which has lain above a picture for some years, but is kept from contact by the mount, will often show on its inner side an outline of the picture, always visible without breath. It seems to be a dust figure easily removed; possibly, heat and light have loosened fine paint particles, and these have been drawn up to the glass by the electricity made in rubbing the outer side to clean it. The picture must have been well framed and sealed up; most commonly dust and damp get in and obscure such a delicate effect.

I am at a loss to imagine simple causes for these varied effects. I am not inclined to think, except in the case of water colors, which is hardly part of the inquiry, that there is a definite material deposit or chemical change; one cannot suppose that imperceptible traces of grease, ineradicable as they may be, would produce complete and delicate outlines. The cleaning off of impressions may at first seem to indicate a deposit; but this renewal of the surface might rather be like smoothing out an indented tinfoil surface: such a view might explain the case where a blank over-electrified disk is developed into fine detail. The electrified figures seem to point to a bombardment, which produces a molecular change, the intensity of electricity bringing about quickly what may also be done by slow persistent action of mechanical pressure. At present it seems as if most of the phenomena cannot be drawn out from the unknown region of molecular agency.

While experimenting I was not within reach of references to former researches, but I have since done my best to find them out, and to indicate all I have learned in the body of my paper.

Poggendorff, vol. lvii., p. 492; translated in *Archives de l'Electricite*, 1842, p. 647.

Riess' *Electrische Hauchfiguren* in *Repertorium der Physik*; translated in *Archives de l'Electricite*, 1842, p. 591.

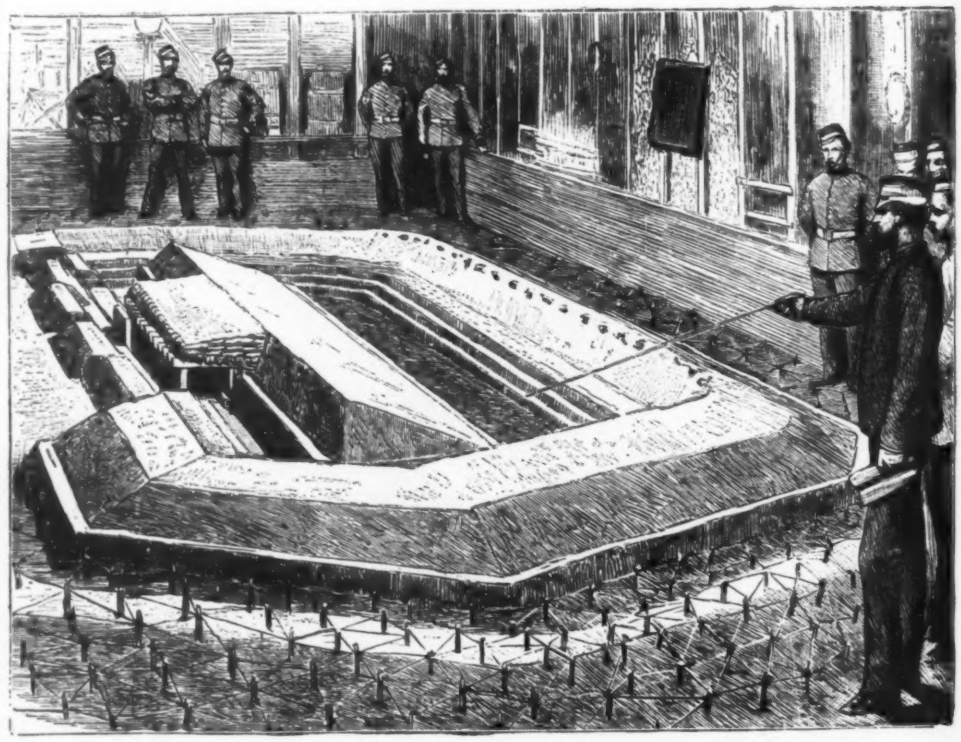
Riess' *Die Lehre von der Reibungs Electricitat*, vol. ii., pp. 221–224.

Mascart, *Electricite Statique*, vol. ii., p. 177.

Taylor's Scientific Memoirs, vol. iii.—*Philosophical Magazine.*

A MODERN REDOUBT.

AN interesting model was exhibited at the recent inspection of the First Lanark Engineer Volunteers by Colonel White, commanding Royal Engineers in North Britain, at the drill hall and ground, Garriochmill Road, Glasgow. Colonel Sir Donald Matthieson, K.C.B., commanded, and the drill ground and hall were set out with engineering work done by the different companies for inspection. A large number of spectators were present, and great interest was shown in the field work and in the exhibits in the hall. The redoubt of which we give an illustration was one of those exhibited in the hall, and was made by men of the First Lanark Engineer Volunteers. It is a sand model, on a scale of one-sixth, of the most modern form of redoubt, and shows the wire entanglements all round the fort, which forms a great feature of the defense of these fortifications. In the drill ground the volunteers constructed bridges, stockades, breastworks, casemates, railways, field kitchens, etc., under the eye of the inspecting officer, who, at the close of the inspection, expressed himself highly satisfied with the work done. Our illustration is from a photograph. —*The Graphic.*



MODEL FOR MODERN REDOUBT, SHOWING WIRE ENTANGLEMENTS IN FRONT.

ST. CLOUD.

ONE of the most famous landmarks of French history is about to disappear. The ruins of the palace of St. Cloud, which was destroyed by the German guns during the siege of Paris in 1871, have been sold at auction by the government for the ridiculously low sum of $800 to an Alsatian building contractor here, who is under bonds to remove within the space of four months every vestige of this ancient palace, upon which countless millions of dollars have been lavished.

Although the fame of St. Cloud as a royal residence dates from the ministry of Mazarin, the place was celebrated for its military importance from very early days. It commanded a very ancient bridge over the river, and in the wars of the Burgundians and the Armagnacs it was the scene of frequent combats. In 1358 the town was captured and burned by the English. In the religious strife of a later age St. Cloud again played a considerable part, and it was in the castle as it then stood that the knife of Jaques Clement ended the life of Henri III. The rare natural beauty of the scenery began to attract men of wealth and taste as soon as the fashion of rearing splendid country houses in the neighborhood of the court sprang up among the ruling classes. Catherine de Medici sometimes lived there, and the magnificent and aspiring Fouquet, the friend of Mme. de Sevigne and the patron of La Fontaine, showed his usual good judgment in building a residence in this delightful spot. Both the demesne of Catherine de Medici and the demesne of Fouquet formed a part of the magnificent park which Louis XIV. acquired for his brother, Gaston of Orleans. The trick by which the Great King is said to have obtained the property at an undervalue is well known. Hervard, the Controller of Finances, had bought it out of the immense gains of his lucrative post. Mazarin, according to the story, asked him what it had cost him. The controller was afraid to tell the truth, for to do so would have involved an admission of the vast profits of his place. He named a ridiculously inadequate sum, and the next day the royal notary attended upon him with the intimation that his royal master desired to purchase St. Cloud at his own valuation.

The new and royal owner of St. Cloud lavished upon it every ornament which the taste of the age could devise and a boundless command of money could procure. The most famous architects, the most ingenious engineers, and the most celebrated painters of France in the bloom of the "Siecle de Louis XIV." did all that art could do for the embellishment of the residence of the only brother of the King. The beautiful gardens, which were laid out by Le Notre, were adorned with cascades and fountains designed by Mansart, and inferior only to those of Versailles and Marly, while the walls of the principal apartments were covered with the dainty work of Mignard. Their efforts, in the judgment of contemporaries, were crowned with success. In all the ring of splendid palaces grouped around Versailles, St. Cloud was the noblest and the most beautiful. It was, says St. Simon, "the home of all delights."

To this home, "Monsieur," as the King's brother was styled in the jargon of the court, took home his charming bride, the fascinating and unhappy Henrietta, daughter of the decapitated King Charles I. of England. The fetes which the newly wedded couple gave to the King outshone all the previous revelries of that magnificent society. Soon afterward the greatest of French pulpit orators was delivering over Henrietta's coffin perhaps the most memorable of all his discourses. The sudden death of "Madame" in the flower of her youth was the first of the domestic calamities which shrouded the close of the great reign in gloom. Like those which followed, it gave rise to dark rumors of poison, which the more sober judgment of posterity rejects. Henrietta was succeeded by a princess of a very different stamp, but not less dear to all students of the court life in those days. The widower married the daughter of the Elector Palatine, and became by her the father of the Regent of Orleans. The anecdotes told of "Madame de Baviere," as she was commonly called, are innumerable, and her own voluminous correspondence with the German relatives to whom her heart always turned formed a most amusing and instructing if not a very edifying picture of the men and women with whom she lived. Louis XIV., to his credit, always loved and honored the sturdy German independence of his sister-in-law, and when at last "Monsieur" fell down in a fit and died after a stormy interview with the King, Louis allowed her to continue to occupy St. Cloud.

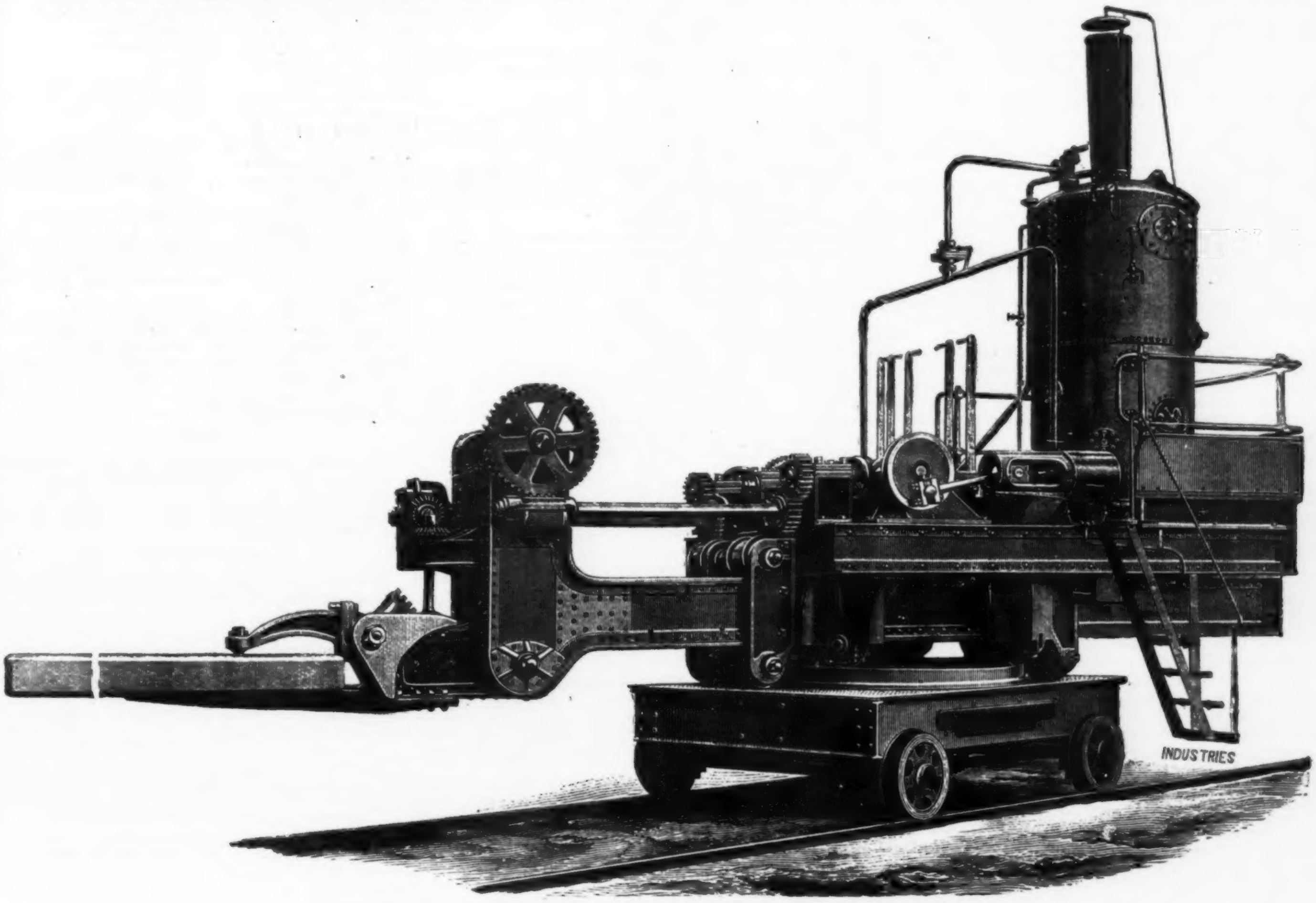
It was here that the Regent received Peter the Great, when that extraordinary man was startling western Europe by his genius, his extravagances, and his brutalities; and here, Louis Philippe d'Orleans spent unheard-of sums in festivities before he sold the chateau and grounds to the unhappy Marie Antoinette. Under the empire, St. Cloud was the theater of many memorable scenes. It was in the Orangerie, indeed, that Napoleon took the first decisive step in that career which planted him upon the throne when on the 18th Brumaire his soldiers expelled the Five Hundred at the point of the bayonet. Here, too, he signed the act proclaiming himself Emperor; here, in the "Galerie d'Apollon," he celebrated his civil marriage with Marie Louise of Austria; and here he seems to have lived by preference when in France. During the restoration St. Cloud was equally favored. It was in

the palace that Charles X. signed the ill-fated ordonnances which led to his downfall, and it was within its walls that he spent the disastrous days of July. The third Napoleon seems to have loved St. Cloud as did his famous uncle, and it was there that he bade farewell to the Empress on the eve of his last campaign. It is the remains of this princely dwelling, so rich in historic memories and in historic lessons, that the rulers of the republic have sent to the hammer.—*N. Y. Tribune.*

LOCOMOTIVE INGOT CHARGING CRANE.

WE illustrate below, from *Industries*, a novel ingot charging crane, which has been designed and introduced by Messrs. Joseph Booth & Brothers, engineers, Rodley, near Leeds. The crane is intended for picking ingots off a platform or floor and charging them direct into the reheating furnace. It has five motions, viz., traveling along the rails of the works, charging and withdrawing the ingot, revolving, lifting, and gripping the ingot. The traveling and swinging motions are produced in the ordinary manner usual with traveling cranes. The ingot is held with a kind of finger and thumb gripper, and is raised and lowered by means of a quadrant. The charging arm, which is worked by a rack, has a travel of about 10 ft., so that an ingot 8 ft. 6 in. long can be manipulated. The crane is perfectly balanced with the ingot at full radius. The principal pinions, wheels, and racks are of steel, and the whole of the mechanism is mounted on a strong wrought iron carriage, having steel axles and tires. The machinery is driven by a pair of horizontal steam engines. The reversing gear and most of the working parts are of steel. The handles for controlling the various motions are brought together so as to be within easy reach of the driver, and the boiler is ample size for continuous working.

The crane shown is at work at one of the large steel works in the north of England, where it lifts the ingots from a platform, charges them into the furnace, withdraws them when heated, and delivers them upon live rollers to the rolling mill, thereby saving a great amount of manual labor.



LOCOMOTIVE INGOT CHARGING CRANE.

PROMOTION OF NAVAL ENGINEERS.

THE following, which we take from the new United States navy regulation circular, will probably be of interest to steam engineers generally.

Before an assistant engineer can be promoted to the grade of passed assistant engineer in the navy, he must have been examined by a board of officers of the medical corps and found physically qualified, and have established, to the satisfaction of a board of officers of the engineer corps, his mental, moral, and professional qualifications to perform efficiently all the duties, both at sea and on shore, of the grade to which he is to be promoted.

A candidate for promotion to the grade of passed assistant engineer must have served at least three years at sea as an assistant engineer on board a naval steamer.

The department will furnish the board with an abstract of the candidate's orders to duty.

Interrogatories will be addressed by the board to commanding officers, and senior engineer officers, under whom the candidate may have served, as to his mental, moral, and professional fitness for promotion.

The candidate shall then be examined upon the following subjects, the board selecting from the sample questions, under each subject, the number specified.

The questions must be so drawn as to be capable of concise answers, and, other things being equal, brief answers will receive more credit than long ones.

In determining the candidate's professional fitness for promotion the board will, for its own information, mark his work in accordance with the scale given below; and no candidate will be recommended for promotion should the aggregate of marks fall below 700. These marks will not be entered on the record sent to the department, but the board will, if the result of the candidate's examination is such as to warrant his promotion, report its recommendation in the form prescribed by Section 1,504 of the Revised Statutes.

RELATIVE VALUATION OF SUBJECTS.

*Record	75
Boilers	80
Engines	70
Valves	90
Condensers and pumps	80
Auxiliary machinery	75
Practical building and repairing	120
Propellers, theory of steam engine	115
Strength of materials	100
Metallurgy	60
Electricity	60
Drawing	30
Modern languages	45
	1,000
Lowest satisfactory	700

BOILERS.

(*Two questions.*)

1. Give brief description of a boiler, explaining the functions of the different parts.
2. Name the different classes of shell boilers commonly used in modern war vessels and describe one (to be selected by board).
3. Name the different tubulous or coil boilers that are generally considered best and describe one (to be selected by board).
4. Give the relative advantages and disadvantages of shell boilers and coil or tubulous boilers.
5. Give brief explanation of different methods of forced draught and state its advantages and disadvantages; what, if any, bad effects it has on boiler; air pressure carried with different classes of boilers; amount of coal burned per square foot of grate surface with different air pressures.
6. Name attachments to boilers and describe any three (to be selected by board).
7. Name the principal causes of the deterioration of boilers and the means of prevention.
8. Name methods of increasing circulation in boilers and describe one with which candidate is familiar.

ENGINES.

(*Two questions.*)

1. Describe briefly the engines used in modern war vessels as regards their position and arrangement of cylinders, explaining the conditions that lead to the selection of one type rather than another.
2. Describe briefly the types of engines used in modern war vessels from the standpoint of the way in which the steam is expanded, and note any changes in arrangement of valves, receivers, etc., consequent on increase of the number of stages in the expansion.
3. Name the attachments to the engines of modern war vessels and describe three (to be selected by board).
4. Explain the means employed to secure powerful engines of comparatively light weight.

VALVES AND VALVE GEARS.

(*Two questions.*)

1. Name the valves used with the engines of modern war vessels and describe the piston valve and one other. Explain the advantages and disadvantages of the two valves described.
2. Name the materials of which valves are made and the liners and false faces to valve seats, explaining reasons for the choice of materials.
3. Name the different kinds of valve gears commonly used with the engines of modern war vessels and describe the Stephenson link and one of the radial valve gears.
4. State briefly the advantages claimed for the radial valve gears most frequently used and state your opinion, with reasons, for the truth or falsity of their claims.
5. Explain the provision made for varying the degree of expansion employed with modern engines using modern valve gears, and what, if any, difficulty, from a practical point of view, there is in using high rates of expansion; also what provision is made to enable the engines to be backed at full power while using a considerable degree of expansion.
6. State any devices with which you are acquainted for reducing wear on the valve gear and for doing the actual work of moving the valves, leaving the eccentric or equivalent device only the work of determining the phases of the valve movement. Describe one of these.

CONDENSERS AND PUMPS.

(*Two questions.*)

1. Describe the principal features of the condensers used on modern war vessels, including the material of which made, method of packing the tubes, provision for proper distribution of the steam, etc.
2. Name the attachments to a modern condenser, including the various pipe nozzles.
3. Describe briefly the air and circulating pumps commonly used with the engines of modern war vessels and give the advantages due to use of independent pumps; also the advantages and disadvantages of combined air and circulating pumps.
4. Describe the type of boiler feed pump most often used and tell why this type is preferred.
5. Name the steam pumps most often used as auxiliaries on board ship and describe one of them.
6. Explain how the pistons and rods of air, circulating, feed, and auxiliary pumps are packed, both for low and high pressures, and for hot and cold water. Tell the material of which the valves of the water cylinders are made for different pressures and temperatures.
7. Name any derangements to which the pumps in previous question are liable, it being assumed that they are in good order.

AUXILIARY MACHINERY.

(*Two questions.*)

1. Name the different types of reversing engines

* The mark on "Record" will be based on the answers to the interrogatory letters.

commonly used with modern machinery and describe one.

2. Describe the evaporators and distillers in common use on war vessels and name the attachments. Give approximate output of an evaporator of given size, when used for making drinking water, and when used for supplying deficiency of feed.

3. Describe any good ash hoist in common use with which you are familiar.

4. Describe briefly the steam capstans and windlasses now fitted to war vessels.

5. Describe briefly any good steam or hydraulic steering gear with which you are familiar.

6. Describe any good engine room telegraph fitted for repeating the signal.

7. Name the different methods of fitting turret-turning machinery and describe one with which you are familiar.

8. Explain the accumulator and regulator used with hydraulic machinery.

9. Name the different types of refrigerating machines used on board ship and describe any one with which you are familiar.

10. Describe any efficient governor used with marine engines.

PRACTICAL BUILDING AND REPAIRING MACHINERY.

(*Two questions.*)

1. Describe briefly the steps in building a marine boiler, including such items as preparing the plates, laying out and trimming to size, flanging, annealing, fitting furnace and tubes, etc.

2. Describe briefly the machine work on a large cylinder of a marine engine after it is delivered from the foundry to fit it for erection.

3. Describe briefly the machine work on any one of the following pieces: connecting rod with forked end; piston rod and cross head; solid crank shaft; built-up crank shaft; propeller shaft and propeller, either solid or with adjustable blades.

4. Describe briefly the operation of boring out shaft tubes and struts.

5. Give a brief explanation of the salient features of moulding, including the kinds of sand used, venting, cores, securing moulds, etc.

6. Describe briefly the process of moulding a large cylinder, either from a pattern or by "sweeping up" and in dry sand or loam. (Cadidate to choose which method and material in which moulded.)

7. Describe briefly the moulding of a composition propeller by "sweeping up" or from pattern and in dry sand or loam. (Candidate to choose.)

8. Describe process of repairing castings by "burning" and explain limitations and precautions to be observed.

9. Explain the process of melting cast iron in a cupola, including a brief description of a modern cupola.

10. Explain the process of melting composition or brass for large and small castings.

11. Explain operation of making copper pipe and note the precautions to be observed to secure good work.

12. Describe process of making a large wrought iron forging; also a large steel forging.

13. Describe method of repairing broken parts of machinery on board ship. (The board to select two cases and state the circumstances.)

14. Describe process of fitting white metal in a bearing and of repairing it if melted out by hot journal.

15. Describe process of fitting lignum-vitæ bearings, giving precautions to be observed.

16. Explain briefly the salient features of pattern making in connection with marine machinery.

PROPELLERS, THEORY OF STEAM ENGINE.

(*Two questions.*)

1. Give the generally accepted theory of propelling instruments and its application to the screw propeller.

2. Describe the essential features of a good screw propeller and explain how far they are carried out in practice.

3. Describe briefly the types of screws commonly fitted to modern war vessels.

4. Explain the advantages and disadvantages of twin and triple screws.

5. Explain the advantages of high speed in marine engines and tell how it is secured.

6. Explain the influence of inertia of reciprocating parts of engines on steadiness of running, and also influence of number and position of cranks on uniformity of crank effort. Explain method of laying out a curve of crank effort.

7. Explain the effect of multiple cylinder engines on economy in use of steam and give approximate figures for steam and coal per I. H. P. in different types of engines.

8. Give the first and the second laws of thermodynamics. Give Carnot's function and explain its use and bearing on the performance of engines in practice. Explain the advantages and disadvantages of using steam of high pressure.

9. Explain the limitations to useful expansion. Show how to compute amount of water used from an indicator diagram and explain why the amount thus calculated is not the same as that found by actual measurement of feed.

10. Explain what is meant by superheated steam and the advantages and disadvantages of its use.

11. Explain briefly why steam is a better vehicle for heat engines than other vapors with less latent heat and lower boiling point.

12. Explain briefly the essential features of a correct reducing motion for steam engine indicators and sketch one form.

13. Explain briefly the construction of the steam engine indicator; demonstrate the degree of accuracy of the pencil movement of any one, and explain what difference in the selection of the piston and drum springs is caused by difference in speed of engine.

14. Explain the standardization of indicators and the necessity for it.

15. Explain the correction of indicator cards by the result obtained from standardization of the indicators, and tell how it is done practically for a large number of cards, as in the case of a trial trip.

16. Draw a good practical card, as obtained from an engine in good condition, and show by dotted lines the result of defect in adjustment or fitting of the valve and other parts.

POWER, DIMENSIONS, AND SPEED OF ENGLISH VESSELS.

THE following summary was recently given by W. H White, director of naval construction:

	Torpedo Boat.	Torpedo Gunboat. Sharpshooter Class.	Medusa, Third Class Cruiser.	Terpsichore, Second Class Cruiser.	Edgar, First Class Cruiser.	Blenheim, First Class Cruiser.	Atlantic, Passenger Steamer.
Length (in feet)	135	230	265	300	360	375	525
Breadth (in feet)	14	27	41	43	60	65	63
Draught (mean) on trial	5 ft. 1 in.	8 ft. 3 in.	16 ft. 6 in.	16 ft. 2 in.	23 ft. 9 in.	25 ft. 9 in.	21 ft. 3 in.
Displacement (tons) on trial	103	735	2,800	3,330	7,390	9,100	11,550
Indicated horse power—10 knots	110	450	700	800	1,000	1,500	2,000
" " " 14 "	260	1,100	2,100	2,400	3,000	4,000	4,000
" " " 18 "	870	2,500	6,400	6,000	7,500	9,000	10,000
" " " 20 "	1,130	3,500	10,000	9,000	11,000	12,500	14,500

Figures for horse power are "round," Medusa's figures for 20 knots on Stokes Bay; other ships for that speed estimated for deep water.

17. Explain briefly the composition of coal. Show how to calculate the thermal value of coal from its percentage composition. Explain briefly chimney draught and the effect of proportions of chimney. Tell the bearing of forced draught on the economy of combustion. Calculate temperature of furnace from data given by board, and tell how it is determined practically.

18. Discuss briefly the economic and practical advantages and disadvantages of using liquid fuel instead of coal on war vessels.

STRENGTH OF MATERIALS.

(*Two questions.*)

NOTE.—In working problems under this subject free use of text books and works of reference will be permitted.

1. Definition of principal terms employed, such as stress, strain, elastic limit, permanent set, fatigue, neutral axis, ultimate strength, safe working strength, factor of safety, modulus of elasticity, etc.

2. Explain the effect of prolonged application of stress and of repetition of stress through wide range; also of alternation of stresses of opposite kinds on safe working strength of a material.

3. Explain how the ultimate strength and elastic limit are determined in practice, and explain what is meant by the expression "strength per square inch." Give brief description of the essential features of any good testing machine with which you are familiar.

4. Describe the effect of variations of temperature on the tensile strengths of the more important metals used in marine machinery.

5. Determine thickness of shell, thickness of furnace, and diameter of braces to heads for a boiler from data furnished by the board. Show how to determine the strength of a riveted joint, as compared with the solid sheet, and state what practical considerations modify the theoretical percentage found, as you have described.

6. Determine the proper dimensions of the piston rod and connecting rod, or the crank shaft, of an engine from data furnished by board.

7. Show how to determine which is the stronger column, a square or round one of same cross sectional area; also, with same cross sectional area, a solid or hollow one.

8. Work a problem in strength of beams from data by board. What is the strongest shape of beam in steel or wrought iron in general use? Explain what governs the choice of I, T, angle, bulb, or Z bars for use as beams.

9. Explain how you would determine the proper size for the key or feather for securing a composition propeller on a steel shaft. Explain the limiting resistance to crushing in metals which "flow" under great stress and state the metals or class of metals which present this quality.

10. Explain briefly the effect of the shape of test piece on ultimate tensile strength and elongation, and tell the general practice in respect of shape and size of test piece.

11. Give the tests, other than by machine, for the steel parts of marine machinery.

12. Explain the difference between the resistance to direct crushing and the resistance to compression, and give some idea of how you would determine when one and when the other would apply.

13. Name the parts of marine machinery now commonly made of forged or rolled steel: also those commonly made of steel castings.

14. Give an approximate figure for the ultimate tensile strength of the following materials, of good quality, such as would be passed for use in marine machinery: Steel boiler plate; wrought iron boiler plate; steel forgings; steel castings; bar iron (small sizes); wrought iron forgings like engine shafts; ordinary navy composition; Muntz metal; naval brass; manganese bronze; phosphor bronze; copper.

METALLURGY.

(*Two questions.*)

1. Name the principal iron ores, and describe briefly the operation of making pig iron in the blast furnace.

2. Describe the common methods of making wrought iron.

3. Explain the distinction between cast and wrought iron and steel, and state what kinds of the latter are adapted to use as parts of marine machinery.

4. Give a general description of the principal methods of making structural steel, and give details of the open hearth process.

5. Explain briefly the difference between the "acid" and the "basic" methods of making steel; and explain the importance of the latter. Explain the effect of the principal metalloids found in steel, and state the maximum amount of each permitted in steel boiler plate.

6. Explain briefly the different methods of making ingot copper, and state what impurities are likely to be found in the ingots, and their effect.

7. Explain briefly the difference between brass and bronze, and explain the effect of varying the proportions of the constituents both as regards strength and other characteristics.

8. Give a brief description of the so-called "strong bronzes," explaining their composition and the theory as to the effect of the special ingredients which give the distinctive names.

9. Give a brief account of the defects found in steel castings and the explanations usually given to account for them.

ELECTRICITY.

(*Two questions.*)

1. Describe the essential features of a dynamo-electric machine, and give a brief account of any standard machine in common use.

2. Explain briefly the construction of electric motors and wherein they differ from dynamos.

3. Define the electric terms in common use in connection with dynamos and motors.

4. Explain the principles of electric lighting by incandescent lamps, and tell what means are employed in practice to secure a steady light, whatever number of lamps may be in use.

5. Explain the advantages of transmission of power by electricity, and state under what circumstances it would be more economical than the direct application of steam power.

6. Give data of relative weight of plant to do a given amount of work (say 100 I. H. P. at point of application) on board ship when steam power is applied direct and when electric motors are to be used, it being assumed that steam is taken in each case from the auxiliary steam pipe.

7. Give a brief description of the storage battery, as now constructed, and state the advantages and disadvantages, in your judgment, of their use in connection with naval vessels or their dependencies.

8. Give precautions to be observed in the practical use of dynamos and motors, and state what mishaps are common or likely to occur.

DRAWING.

The candidate will be furnished a blue print of some portion of the machinery of a naval vessel and will be required to write a description of it, telling the different materials employed and explaining the object of any special features.

MODERN LANGUAGES.

The candidate may choose either French, German, Italian, or Spanish as the language in which he wishes to be examined.

He will be required—

1. To translate a short selection from any good author or newspaper, and not of a technical nature.

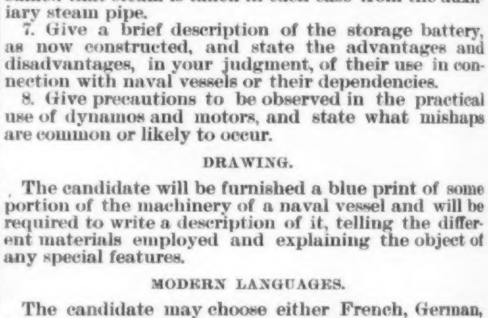
2. To translate a short selection from some book or journal treating of marine machinery.

The translation will be free, but must preserve the meaning of the original.

B. F. TRACY,
Secretary of the Navy.

VOGELSANG'S SYSTEM OF JET PROPULSION OF SHIPS.

MR. VOGELSANG's invention relates to the propulsion of ships by means of jets of water ejected from the vessel in an opposite direction of its intended course against the water of flotation. In carrying out his invention Mr. Vogelsang uses two or more jets of water, and in order that the jets shall constantly act upon comparatively undisturbed water—that is to say, upon water which has not acquired velocity, owing to the jets being constantly directed in one line—he arranges the nozzles through which the jets issue in such a manner that they may be revolved around an axis for delivering the jets in circular paths. Referring to our illustration, Fig. 1 represents in sectional side elevation

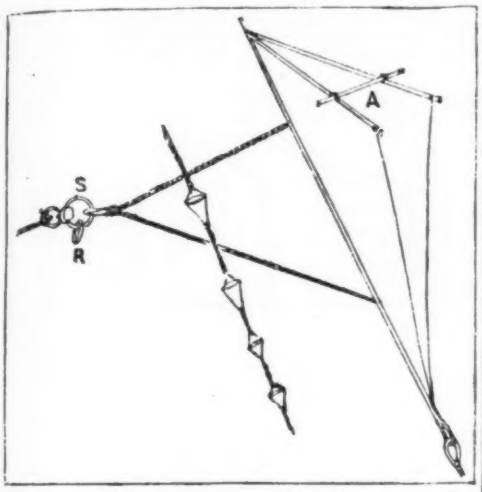


so much of a ship as is necessary to illustrate the application of the invention thereto; and Fig. 2 is an end view. *a* indicates the hull of the vessel and *b* a pipe which communicates with a centrifugal or force pump, or any other suitable water-forcing device for raising and discharging water. b^1 is a pipe which forms a continuation of the pipe, *b*, and which is mounted in a stern tube, *c*, and thrust-bearing, *d*, similarly to the ordinary propeller shaft of a steamship, in order that it can be rotated. *e e* are tubes or nozzles projecting from the outer end of the pipe, b^1, and serving to cause the water forced through the said pipe to issue therefrom in the form of powerful jets, the nozzles being

equidistant from the axis of the pipe, b^1, as clearly shown in Fig. 2. *f* is a stuffing box for making a watertight joint between the pipes, *b* and b^1. *g g*¹ are gear wheels, the former of which is secured to the pipe, b^1, while the latter is secured to a shaft, *h*, to which rotary motion is imparted by any suitable motor in order to cause the rotation of the pipe, b^1. *i* is a casing which surrounds the nozzles, *e*, and serves to prevent them from being damaged by contact with anything floating in the water, and *j* is a cone which is advantageously placed between the nozzles to prevent the formation of a partial vacuum as the vessel moves through the water. The operation of the apparatus is as follows: Water is forced through the pipes, *b* b^1, to the nozzles, *e e*, from which it issues in powerful jets, and at the same time rotary motion is imparted to the pipe, b^1, causing the outlets or nozzles to revolve, so that the jets constantly act against undisturbed water. When only two or three nozzles are used, they must be equal distance apart from the axis, in order to balance the pressure; when four nozzles are used, each set of two may be at different distances from the axis from the other set. Instead of water other fluid jets may be used.—*The Steamship.*

LIFE SAVING DEVICES.*

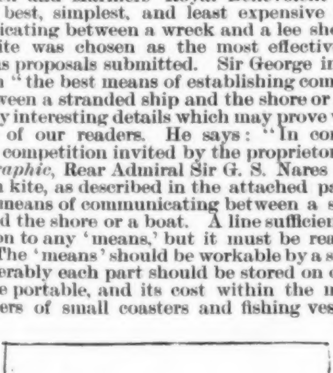
THE storm kite of Sir George Nares has the merit of being a successful invention. After a public competition for the prize offered in 1861, by the Shipwrecked



THE NARES STORM KITE.

(From sketches sent by Rear Admiral Sir George Nares, K.C.B.)

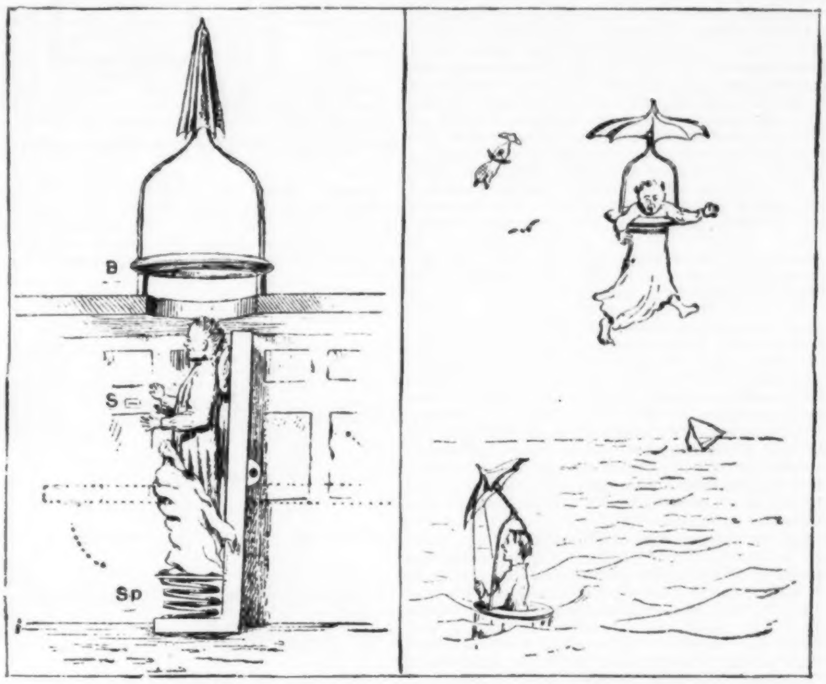
Fishermen and Mariners' Royal Benevolent Society, for "the best, simplest, and least expensive mode of communicating between a wreck and a lee shore," the Nares kite was chosen as the most effective of the numerous proposals submitted. Sir George in his remarks on "the best means of establishing communication between a stranded ship and the shore or a boat," gives very interesting details which may prove valuable to some of our readers. He says: "In connection with the competition invited by the proprietors of the *Daily Graphic*, Rear Admiral Sir G. S. Nares submits his storm kite, as described in the attached papers, as the best means of communicating between a stranded vessel and the shore or a boat. A line sufficiently long is common to any 'means,' but it must be reasonably strong. The 'means' should be workable by a stranger, and preferably each part should be stored on deck. It should be portable, and its cost within the means of the owners of small coasters and fishing vessels. It



A MASTHEAD ROCKET APPARATUS

(From a sketch by Mr. Neil MacVean.)

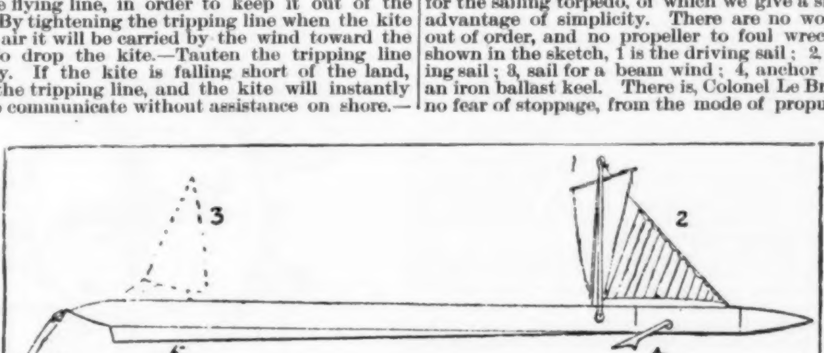
should be capable of being repaired on board the vessel, and, as far as possible, of being extemporized. When the weather is calm, when the wind is off shore, when there is a light wind *on* or along shore, 'the best means to establish communication' is by the ordinary means of a boat and heaving line. There remain such times as when a boat cannot be used. The commonest time of all is when there is a strong wind *on* shore. 'The best means' is by the Nares storm kite, and the ship's ordinary log line, about 150 yards long, in connection with the patent log line, deep sea line, or other communication line. The rarer occasion when there is a strong wind *along* shore. Whatever means are used, this is the most difficult case of all. I submit that the Nares storm kite, with a side tripping line, is the best. The kite is fitted to fly in a strong wind when communication by ordinary means is difficult; in light winds lighter canes and tail must be used. The specialty of the storm kite is: 1st, That, as the sides are capable of bending back, it presents a projecting breast toward the wind; this allows the wind pressure on its surface to be regulated, and insures that the kite flies steadily in the strongest storm; 2d, that, by means of a second line, it can, when required, be brought to the ground, either in a line directly in the course of the wind, or at an angle to the right or left of the course of the wind. The kite can be flown from the deck of the vessel or any other position where the force of the wind is fairly steady. If the wreck is



"PUT A PENNY IN THE SLOT." (Suggested and sketched by F. W. Wilson.)

opposite a favorable shore the kite can be used, without assistance from the shore, to drag each man to the beach, with or without the help of a life buoy. If assistance is obtainable, the kite can be used to drag a line on shore, by means of which communication may be established.

"To fly the kite, use the common log or other similar line, securing it to the swivel, S. Take a turn with it round a cleat, ready to veer away. Secure the tail to the bottom of the diagonal cane, and see it clear in or out of the water. Open the kite by means of the cross stick at the back, A, spreading it in accordance with the strength of the wind. To communicate with people on shore.—After the kite is steady in the air, attach to the kite line the deep sea lead line, or by means of a second line hanging from its bight a life buoy, small cask, or any other article that will float. Veer it to the shore. If rocks intervene.—The kite when ever the land can be lowered to the ground by using two lines, that is, the kite line and a tripping line. The end of the tripping line should be rove through the ring, R, and if the wind is blowing directly toward the land, be secured to the bottom of the kite. If the wind is not blowing directly toward the shore, secure it to the off shore side of the kite. In flying the kite, keep the second line slack. Festoon it up to the flying line, in order to keep it out of the water. By tightening the tripping line when the kite is in the air it will be carried by the wind toward the land. To drop the kite.—Tauten the tripping line gradually. If the kite is falling short of the land, slacken the tripping line, and the kite will instantly rise. To communicate without assistance on shore.—



A SAILING TORPEDO. (From designs by Lieut.-Colonel E. Le Breton.)

After the kite is steady in the air with about 100 yards of the line out, secure one end of about twenty yards of line to the bight of the kite line and the other end to a life buoy. By means of the life buoy the kite can be used to drag one or more men to the shore. The kite can also be used to take a line to a boat to leeward unable to fetch the ship; to communicate with a lighthouse or between vessels at sea when a boat cannot be used; to carry a line across a river, and other similar cases."

The other sketch given above is of a design by Mr. Neil MacVean—an attempt to improve the present system of handling rockets. The idea is to have a box permanently fixed at the masthead containing rockets. These are to be fired out of a tube fixed so as to be capable of being pointed in any direction. The rocket would be connected with a light log line on a reel fixed permanently somewhere near, as shown in the sketch. Mr. MacVean would have a duplicate box on deck, and he also suggests a torpedo.

We have received, with two amusing sketches, the following letter from Mr. F. W. Wilson, Elmhurst, Kenley, Surrey:

"This is certainly the proudest moment of my life. I have from day to day watched with eager interest the competition for the best means of communicating between ship and shore, and it has been with the greatest difficulty that I have hitherto restrained myself from sending you the *only* practical suggestion yet submitted, the very *bonne bouche* of the competition. A brilliant idea, which makes all others sink into insignificance—which makes mine alone 'practical,' and all others 'otherwise.' My sketches, although so poor, will doubtless speak for themselves. Sketch 1 shows the automatic berth. The passenger, immediately on feeling the shock of the steamer running upon some hidden rock, places a penny in the slot, S; the berth directly assumes a vertical position, the strong spring below the sliding board at the feet (S P) gives way, and the passenger is shot up through a hole in the roof of the cabin, carrying with him a life buoy surmounted by a parachute. The parachute opens (see sketch 2), and he sinks gradually into the ocean. The parachute can then by the simplest means be converted into a sail, and the shipwrecked passenger arrives in safety on the shore. Why has not this been thought of before?"

Lieut.-Colonel Le Breton is well known in the yachting world, and especially as a yacht designer. He has had great experience of the sea, not merely as a yachtsman, but as a circumnavigator, and knows all classes of vessels. He says that in designing his torpedo he has only taken the case of wind on shore or at least of wind parallel with the shore, as if the wind is off the shore the ship is presumably in smooth water, and can communicate at her leisure by her boats, or, if these are gone, by some extempore float. He claims for the sailing torpedo, of which we give a sketch, the advantage of simplicity. There are no works to get out of order, and no propeller to foul wreckage. As shown in the sketch, 1 is the driving sail; 2, the steering sail; 3, sail for a beam wind; 4, anchor flukes; 5, an iron ballast keel. There is, Colonel Le Breton says, no fear of stoppage, from the mode of propulsion failing to act, and stowage is as easy as that of a common spar. He adds: With regard to kites, rockets, clockwork torpedoes, etc., I consider they are all barred by the condition that the line shall be self-holding. No kite will lift a strong enough line and grapnel for any distance, anything less than a 2 in. (circumference) line being useless. The same applies to rockets, and clockwork and pneumatic torpedoes, unless the latter are of enormous size and weight, and the propellers of the latter would be almost certain to foul either their own towing line or the almost inevitable wreckage and loose gear alongside the ordinary ship in distress.

* Continued from SUPPLEMENT, No. 869, page 13893.

AGING LIQUORS.

THOSE essential characteristics of all alcoholic liquors which serve to give them their distinguishing peculiarities of flavor and bouquet are all due to the so-called fusel oil of the liquids. This fusel oil is produced during alcoholic fermentation as a by-product. That is, the main result of the fermentation is the production of ordinary or ethyl alcohol and carbonic acid gas, but fusel oil is also produced in small quantities. Just how it is produced is as yet a mystery. It is not the same in all liquids, inasmuch as it is not a simple body itself, but is a mixture of several, the identity and proportions of which vary according to the nature of the substance undergoing fermentation, as well as with the kind of ferment used. Grain mashes produce more of it than a mash made of potatoes and of grain mashes; one made of Indian corn, a grain rich in albuminoids and fats, seems to be especially productive of these substances. Moonshine whisky contains, it is said, a very large percentage of fusel oil, probably for the reason that none of the fatty matters are removed from the corn before mashing and none of the undesirable products of fermentation are removed by rectification during or after distillation, expedients which are practicable only when distillation is carried on upon a large scale. Fusel oil consists mainly of several of the higher alcohols. Those produced in the fermentation of malt are propyl, butyl and amyl or pentyl alcohols, pincipally the latter. Formerly, fusel oil was supposed to consist entirely of amyl alcohol ($C^5H^{11}.OH$), but it is now known that other alcohols are present in small quantities. Of the eight isomerides of amyl alcohol, but one, isobutyl carbinol, is directly produced by fermentation. In raw brandy, œnanthyl or heptyl alcohol ($C^7H^{15}.OH$) seems to be the predominant prevailing agent, although hexyl or caproyl alcohol ($C^6H^{13}.OH$) is also present. These alcohols are all evil smelling and tasting bodies, remarkable for their harmful effect upon the system. The toxic effect of alcohols is believed to increase as they ascend the series. The well known injurious effects of moonshine whisky and of raw brandy are attributable, probably, to this fact. Besides the alcohols just mentioned, the production of ordinary or ethyl alcohol is often accompanied by the appearance of small quantities of various acids and ethers formed by the reaction of the acids upon the alcohols, and fatty matters of a nature analogous to that of the essential oils and camphors.

Aging liquors, the subject of this article, has, however, little to do with any of these bodies except the higher alcohols. Attempts are sometimes made to remove or coagulate the albuminous matters present in these liquids, but this relates to purifying rather than aging. The chief aim in aging liquors is the conversion of the alcohols other than ethyl alcohol into corresponding ethers. Inasmuch as ethers are oxides of alcohols, this must be effected by oxidation. Sometimes, owing to various causes, the oxidation is either incomplete, or carried too far, when aldehydes or acids may result. In the main, however, the process of aging malt liquors and the spirits distilled therefrom consists in the conversion of the evil smelling and tasting propyl, butyl and amyl alcohols, especially the latter, by the aid of oxygen, into corresponding or related pleasant tasting and harmless ethers, and the aging of wines and brandies consists essentially in the corresponding conversion of caproyl and œnanthyl (hexyl and heptyl) alcohols.

This oxidation is slowly effected when the wines or liquors are exposed to the action of the air in partially filled casks.

This is the time-honored process of our forefathers.

This was supplemented and hastened occasionally by placing a few casks of new liquor in the hold of a ship about to sail on a long voyage. The pitching and rolling of the vessel caused a constant agitation, which resulted in bringing into contact with the air fresh particles of liquor much more rapidly than when it was allowed to remain at rest, thereby effecting a much more rapid and complete oxidation. In storehouses the casks are rolled frequently for the purpose of effecting the same result and a number of devices have been patented, the object of which is to shake or agitate the liquor in bulk so as to effect the same result.

Other devices directed to the same end have also been devised in which the liquor or the air, or both, are broken up into fine streams or particles, whereby more intimate contact and more rapid and complete oxidation is effected.

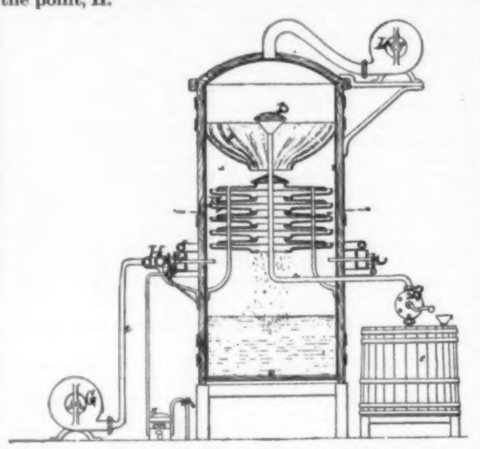
There are several agents besides the physical ones mentioned which can be relied upon to accelerate the effects of the oxygen.

These are briefly pressure, heat, light and electricity.

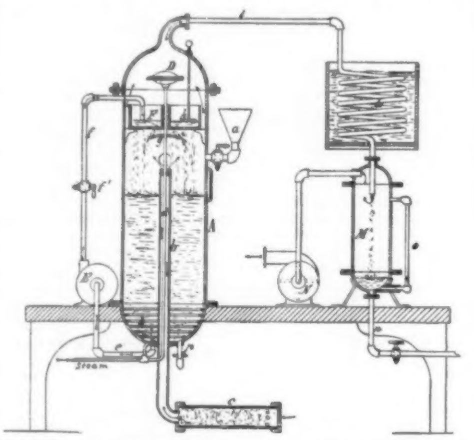
The effect of any of these, or all of them—for though there is no recorded case where they have all been together, no reason can be seen why they should not all be used—is to energize the oxygen and to enable it to effect its purpose more quickly.

Another expedient sometimes resorted to is the employment of oxygen-bearing substances, the nascent oxygen effecting a very speedy result. This latter is however open to certain objections, to be pointed out later on. Aging is then an oxidation, and this oxidation may be accelerated and assisted by bringing the particles of liquor into intimate contact with the oxygen molecules through mechanical agencies by the employment of heat, light, electricity, or all of these. It is proposed to give briefly one or more examples of each of these as revealed by the following domestic and foreign patents. No attempt is made to do more than briefly indicate the character of the means employed in a few typical cases. It is well to bear in mind that in every case in which oxygen is employed, whether in a pure state or in combination with the nitrogen of the atmosphere, the effect is very much increased if it be converted into ozone. Many elaborate plants have been established for ozonizing air or oxygen for this purpose.

United States patent to Turner, No. 111,791, Feb. 14, 1871, shown above, exhibits a means for thoroughly aerating the liquor and treating it with ozone or ozonized air. The liquid is brought in by pump, B, sprayed through rose, D, and falling back upon the disks, F, meets the air which is led in by the pumps, G and L. The ozonization is effected by a burner at the point, H.


TURNER'S APPARATUS FOR AGING LIQUORS.

Clark's patent, No. 192,635, July 3, 1877, is a device of the same general character, the difference being mainly in the employment of a steam-heating coil and the condensation and collection of the vapors carried over by the filtered air that is forced through the liquid.


CLARK'S APPARATUS FOR AGING LIQUORS.

Ramsay in his patent, No. 243,157, June 21, 1881, shows an apparatus (shown here also) for the purpose of subjecting the liquid in a series of chambers to violent shocks or concussions.

He states that the "fusel oil contained in distilled liquids is generally believed to be small oil sacs which are distributed throughout the mass; and in order to thoroughly oxidize or age the liquid, these sacks must be broken up and the contained fusel oil disseminated throughout the mass. In this state the oil will decompose into a number of volatile ethers, . . . and in order to produce this result, the oil sacs must be broken up and the whole mass brought into contact with oxygen, either in the form of atmospheric air or pure oxygen." In order to effect this result, the fluid is put from the closed tank into the chambers, B, C, D, in succession. Each of these chambers is supplied with heating arms. The liquid gradually passes into a gaseous condition as it passes into the largest chamber and is constantly brought into contact with the oxygen forced by blower, H, into the chambers and finally condensed in an improved condition in chamber, G.

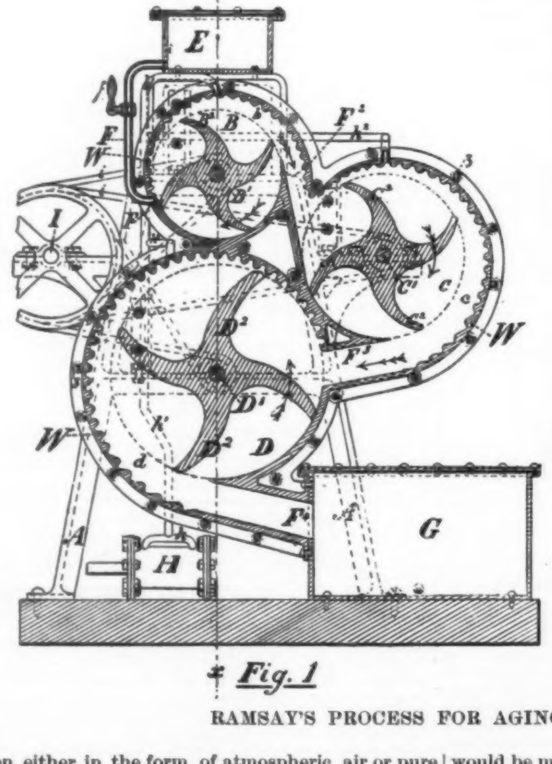


Fig. 1

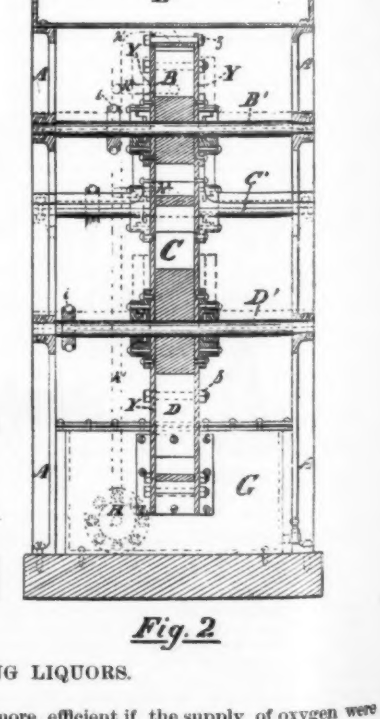


Fig. 2

RAMSAY'S PROCESS FOR AGING LIQUORS.

The advantage of a comparatively high temperature, say 80° to 120° F., in the treatment of liquors has long been known, and this is of especial importance in the presence of oxygen. However, care must be taken on the other hand that the process is not carried on too rapidly, or it may result in the oxidation of a portion of the ethyl alcohol and its conversion into acetic acid. This is precisely the process described in British patent to Brydges, A. D. 1882, August 9, No. 3,789. A discussion of this effect does not, however, properly belong to this article.

Careful distinction must be made between aging spirits and between rectification of spirits, purification of spirits, and pasteurization of fermented liquors. Rectification is the separation during the process of distillation of certain undesirable distillates, which are separated from the potable distillates generally by evaporation at a lower or higher temperature. That is, roughly speaking, it is a species of fractional distillation. Spirits are also purified by removing therefrom the fusel oil by treating it with certain solvent bodies as well as by certain other processes. These processes are useful in obtaining commercial alcohol rather than obtaining a potable product. They are sometimes called cold rectification. Pasteurization consists in the destruction, generally by heat, of certain ferments which, if left alone, would in course of time injure or destroy some fermented liquors.

The United States patent to Purdy, 108,388, Oct. 18, 1870, shows an apparatus designed to discharge heated air or oxygen by jets into the spirits contained in the tank, D. The air or oxygen is heated in the vessel, A, by hot water or other means, and to a temperature of from 90° to 120° F., and the vapors carried over are condensed in the worm, E, which is surrounded by cold water.

Fig 1

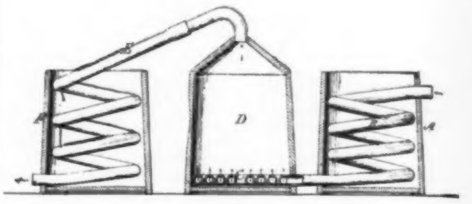
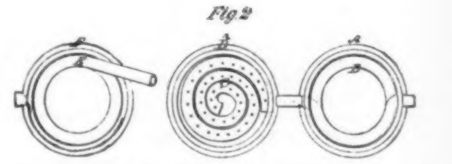


Fig 2



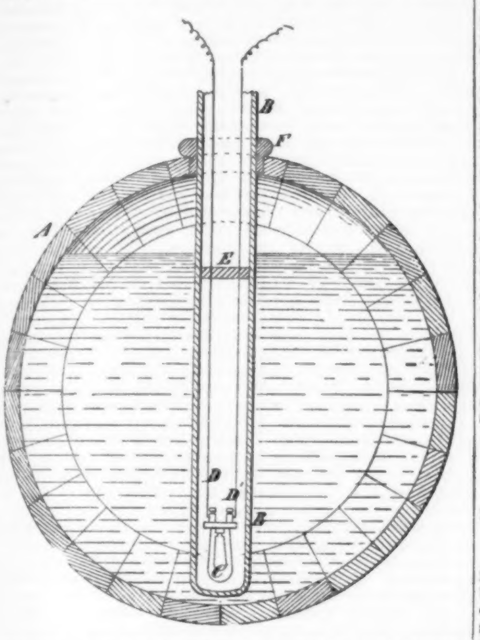
PURDY'S APPARATUS FOR AGING LIQUORS.

The patent to Crossman and Marland, No. 97,889, Dec. 14, 1869, describes a process for improving whisky and other alcoholic spirits which consists in subjecting them to a temperature of 232° for eight and one-half hours in a steam-tight digester. The digester is only partially filled, the remainder of the space being occupied by air. By this process almost all evaporation is prevented. It is probable, however, that the process would be more efficient if the supply of oxygen were renewed from time to time.

A somewhat curious but doubtless efficient process is described in a patent to Fleischmann, No. 89,748, May 4, 1869. He fills a vessel with porous substances whose nature is such as not to impart taste to the liquor,

such as wood of certain kinds, pith, cotton, corn cobs, etc., and afterward pours in raw liquor. The fusel oil is absorbed by the porous substances more rapidly and readily than the ethyl alcohol and water. The unabsorbed portion is then drawn off and air is made to circulate through the cask. "The oxygen changes the more carbonized alcohol into acids and compound ethers which give that peculiar aroma proper to certain alcoholic liquors." The porous substances thus charged with these acids and ethers are then used to impart flavor and bouquet to such liquids as are deficient therein.

The effect of sunlight upon wines was early noticed by Pasteur, and, together with the effect of oxygen, is found described in his *Etudes sur le Vin*, 2d ed., p. 112 *et seq.* He found that the wine, after an exposure to sunlight lasting from one to six months, was much clearer and had formed a deposit much greater than that formed in a portion of the same wine kept in darkness. The deposit he found to consist of (1) salts, *i. e.*, bitartrate of potash or neutral tartrate of lime or

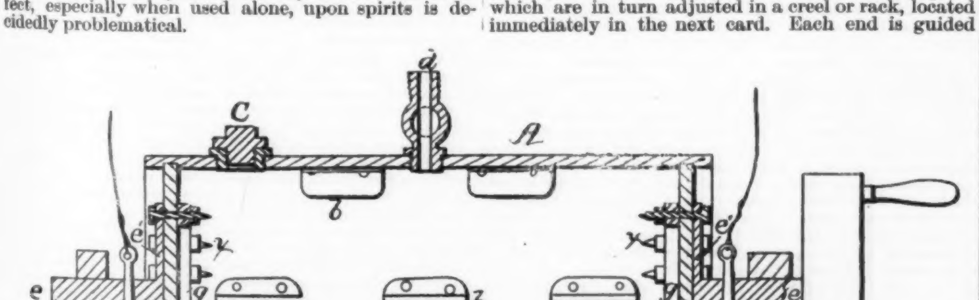


FITCH'S APPARATUS FOR AGING LIQUORS.

both, (2) coloring matters, and (3) cryptogamous micro-organisms, to which, in the first portion of his work, he attributes vicious fermentations. As none of these substances, except, perhaps, a little coloring matter, are found in spirits, his researches have little to do with the subject of this article. However, patents have been granted in which it is asserted and claimed that sunlight plays an important and useful part in the aging of alcoholic liquors. German patent to Michaelis, No. 26,036, June 22, 1883, affords one example. The patentee describes and shows an apparatus by means of which "vinegar, wine, brandy, and other alcoholic liquids, perfumes, extracts, etc., are concentrated and aged." He provides a tank which is heated to a moderate temperature and furnished with means to retard the flow of the liquid therethrough, with glass cover, using also a lens, if desired, to concentrate the light. The liquid flows slowly through the apparatus and is exposed to the effect of light, heat, and also air. In an addition to this patent, No. 28,817, October 21, 1883, another factor, agitation, is described as useful in addition to the foregoing.

In British application, A. D. 1875, January 20, No. 213, the startling assertion is made that "if raw malt whisky, in quart bottles of clear glass, is fully exposed to strong direct sunlight for an hour, its flavor and odor will be rendered equal to that of the same whisky which has been thoroughly aged in the ordinary way."

This is the only instance found in which to light alone is attributed any effect upon spirits, and protection for this application was refused in the British Patent Office. Sunlight has undoubtedly the effect which Pasteur has pointed out upon wine, but its effect, especially when used alone, upon spirits is decidedly problematical.



MONT STORM'S APPARATUS FOR AGING LIQUORS.

U. S. patent to Fitch, No. 334,222, January 12, 1886, shows a device in which the warmth and light from an incandescent lamp are used to produce the desired effect. The light is comparatively feeble, and the effect due to its illuminating power is very little, and probably none.

Electricity is another agent sometimes employed. A sufficiently powerful current will doubtless destroy any micro-organism in wine or beer, and may, in some cases, cause a separation of the fusel oil. Its only proper aging effect in the treatment of wines and liquors is probably in connection with oxygen, when, like heat, it seems to give the oxygen molecules an increased activity. This is the effect attributed to it by Mont Storm in his U. S. patent, No. 57,009, August 7, 1866. The oxygen is supplied from the decomposition of water by the current, and in its nascent condition attacks and oxidizes the fusel oil. Probably, in all effective electrical devices for this purpose, the action is substantially the same.

The chemicals used in treating liquors may be classed in two groups, according to the purpose for which they are intended. Those of the first group effect the purification of the liquor by forming insoluble or harmless compounds with the acids or other undesirable bodies present, and hence are purifying rather than aging means. The oxidizing agents employed are the ordinary compounds used for producing oxygen or oxidizing effects, viz., alkaline chromates and manganates, alkaline, silver and hydrogen nitrates, and peroxide of hydrogen, barium, nickel, cobalt and manganese. With silver nitrate and potassium chromate, light seems to be useful. British patents Nos. 12,380, of 1848; 2,864, of 1855; 1,050, of 1879; and 1,866, of 1882, all set forth the use and advantages of some of the substances mentioned, and the reader is referred to them for a more extended knowledge of the subject. Owing to the fact that some of the substances mentioned will oxidize ethyl alcohol, it is probable that their use is attended with a certain amount of risk and injury.

In the foregoing discussion, brevity has made necessary the citation of only those patents which, it is believed, best exemplify the principles involved, and in no case have the relations of patents to each other, as leading and subordinate, or their chronological sequence, been regarded. C. C. STAUFFER.

CARDING TEXTILES.

By GEORGE MAYNARD.

METHODS OF CONVEYING MATERIAL FROM ONE CARD TO ANOTHER.

THE fundamental object in view when arranging for transferring the partially carded material from the first to the second breaker and the second to the finisher is to obtain as perfect uniformity as possible by presenting the fibers in a new form to the following machines.

There are practically three distinct methods of conveying the material from one machine to the other, each of which is sufficiently diversified in its principle of mechanism and operation to be classified under an individual head; therefore, the following classification is made:

1. The balling or side-drawing system, in which the fibers are twisted around each other in the form of rope, and thus delivered to the next machine in respective order.

2. The Scotch-feeding system, by which the fibers are transferred from one card to the other in the form of a flat ribbon of several thicknesses of fibers, some five inches broad.

3. The lap system, by which the fibers are conveyed direct from the doffer of one machine to the next one in the form of successive layers.

1.—THE BALLING OR SIDE-DRAWING SYSTEM.

This system may be again subdivided into two classes, namely: (A) the hand method, (B) the self-operating method.

The most primitive form of feeding will be first considered. This form is found under the head of the first subdivision of this section, and consists substantially of feeding the product of one machine to another by forming it into balls or spools. This is accomplished by arranging for the wool to pass into a small tunnel situated at one end of the doffer.

The rapid motion imparted to this tunnel communicates a degree of twist to the fibers as they pass through; therefore, it is given sufficient strength and elasticity to resist the strain attendant upon the future operations to which it is subjected. When the material, which is now in the form of a rope, emerges from the tunnel, it is automatically wound on to wooden spools which are in turn adjusted in a creel or rack, located immediately in the next card. Each end is guided into the feed rolls by a series of pins through which they pass.

A distinguishing feature of this old-fashioned mode of transferring the wool is that the fibers are fed to the feed rolls of the second machine in precisely the same condition that they are delivered from the doffer to the first one.

Many authorities have contended that the method of delivering the material in such way that the fibers all enter the feed rolls end first, and in parallel line with each other, has many advantages over the method of delivering them in such a way that they enter the feed rolls sidewise, and therefore must be rearranged again in a uniform line. This hand method retains the fibers in a straight line throughout.

The second method classified under this division is conducted altogether by mechanical operations. The filaments are taken from the doffer of the preceding machine in substantially the same manner as that employed in the former method. A similar degree of twist is imparted to the strand of fibers, but instead of its winding on to a spool, it is conveyed directly to the feed table of the following card, by an apparatus known as the Apperly feed.

In the former instance the side drawings were necessarily passed straight through the card, consequently the only amount of doubling acquired was that resulting from the spiral wrapping of filaments about the body of the product. In the latter case, however, the Apperly feed arranges the strands on the feed table in such a way that from 35 to 60 rows are diagonally adjusted in position and enter the feed rolls. It is estimated that as many as 400 doublings are obtainable from 40 rows, which may be increased to 500 by crowding in 10 more.

As there are a large number of these feeds in successful operation throughout the United States, we will devote some space to a discussion of its various merits.

It is very essential that the feed rolls, the licker-in, and, in fact, the entire mechanism of the feeding system be in excellent condition in order to obtain good results from the Apperly feed. If grease and other foreign substances are permitted to accumulate on the rolls, the effects will be noticed quicker than where the rack and spool system is employed.

An extra ring on the outside of each doffer of the finisher is required when this method of feeding is adopted; the waste thus obtained, however, is fed into the first breaker again; therefore, there is no practical objection to this matter. Moreover, the majority of automatic feeding mechanisms require these extra rings, and it is also well to note that these outside ends are all always more or less irregular in size under any circumstances, and if not thrown out, they must necessarily produce uneven yarn and eventually uneven cloth.

Skill and experience are sometimes necessary in order to adjust the several machines at a perfectly uniform speed, which is quite essential for good work. A set of cards is generally arranged in a line, one machine in front of the other; hence the driving pulleys are so far apart that it is impracticable to run them all from a single shaft; therefore, unless each of the shafts employed are revolving at precisely the same speed, it must follow that a difference in the speed of the cards will exist. The result of this diversification may be easily comprehended; the roping will either run so loose that it will pile up on the floor or it will tighten and pull apart.

Either way is a source of considerable trouble, but may be effectually obviated by regulating the speeds of each shaft or by remedying whatever is the fundamental cause of the evil. If the roping lies too narrow or too wide on the feed table, it may be probably adjusted by a contrivance arranged for the purpose. It is usually estimated that the feed should be spread one-half inch inside of the full width of the clothing on the card. This prevents the accumulation of loose wool on the edges of the strippers and workers. The speed of the feed table should be regulated to travel sufficiently fast to prevent the alternate layers of material from overlapping each other.

2.—THE SCOTCH OR RIBBON SYSTEM.

By the Scotch or ribbon system the material is conveyed from one machine to the other in the form of a flat ribbon, about five inches in width and one-quarter or one-half inch in thickness. This flat ribbon of filaments is conveyed from the doffer of the preceding card to the feed rolls of the following one, by passing over a series of elevated pulleys and belts. When it arrives at the feed table of the receiving card, a mechanical movement distributes it back and forth in a parallel line with the feed rolls, flat side downward.

Simultaneously with this movement, the feed is gradually propelled forward; thus each layer overlaps the one preceding it about one-third its width, therefore forming successive layers of narrow laps. It is evident that this method arranges the ribbons on the feed table in such way that the fibers are presented to the feed rolls sidewise; hence the principle does not differ much from that of the Apperly feed, for in both these systems the fibers leave the doffer lengthwise, and are fed on to the table of the following card transversely.

3.—THE LAP SYSTEM.

By the lap system of conveying the material to the following card the wool is spread out the full width of the doffer on to a broad traveling lattice, which operates on a level with the middle of the doffer. Beneath the creeper or lattice sufficient space is allowed to permit the free working of a transverse apron which operates forward and backward on a track. A layer of the thin film of wool is uniformly spread on this apron simultaneously with each movement, resulting in the formation of a "lap." The thickness of this lap is regulated by changing the relative speed of the delivery and traveling apron situated below.

This traveling apron advances forward a specific space at each successive forward and backward movement, thus carrying the lap along to the end of the apparatus, where it is automatically wound in the form of a large roll. This roll is deposited on the feed table of the next card, and fed to the machine in that way. Frequently the laps from two and sometimes three separate rolls are allowed to enter the feed rolls simultaneously by adjusting one ahead of the other;

therefore a far greater uniformity is obtained in the product from that card.

As the previously mentioned lattice or apron which receives the lap operates at right angles to the film which is delivered from the doffer, it is evident that the filament must enter the feed rolls of the following card at right angles, or sidewise instead of endwise. Consequently the fibers are submitted to another course of disentanglement and rearranging while passing through the cylinders and rolls of the second card. If the same system is employed for conveying the wool from the second breaker to the finisher, a third disentanglement and rearrangement is effected. This continual working of the delicate fibers is not recommendable for yarns intended for use in the warp, or for yarns necessitating an excess of strength, elasticity and durability, for experience has shown that such excessive carding must necessarily produce a comparatively much larger number of "points" or miniature breaks, and similar defects in the staple, than the method of presenting the fibers to the following machines in substantially the same form they are taken from the doffer of the preceding one.—*Manufacturers' Gazette.*

OIL AND IRON STAINS IN COTTON CLOTH.

OIL stains in cotton cloths are an occurrence well known to every bleacher and dyer, and it is the general experience that their complete removal is effected in the keiring process. This is absolutely certain where the oil stains have been caused by animal or vegetable oils and greases, as in this case, under the circumstances obtaining in keirs, the saponification of these oils completely removes the stains. Not quite so simple is the case if the stains are caused by mineral oils. These are incapable of saponification, but as soap solutions (especially alkaline ones) dissolve considerable quantities of mineral oils, it is generally assumed that the resin soap employed in the process of keiring emulsifies, and eventually dissolves also these stains. This may be true as long as the stains are fresh, but it applies not to old stains, which through long exposure to the air have undergone oxidation. Cloth containing such mineral oil stains cannot be effectively dealt with in an open keir, although in a pressure keir, and conditional to a liberal supply of resin soap, the stains practically disappear, *i. e.*, they can no longer be seen; and in the process of printing or dyeing such cloth, nothing occurs that would indicate that these oil stains are still in existence. Iron stains, perhaps, occur not so often in cloth as oil stains, and may prove a great nuisance occasionally, but under ordinary circumstances their removal is easy enough. If the stains are few and far between, they are treated one by one with a moderately strong solution of oxalic acid, the piece being subsequently washed. If there are too many of these stains in a piece to apply this treatment, padding in a bath of oxalic acid at 5° Tw. or in bisulphite of soda at 7° Tw. will answer.

If, however, oil and iron stains appear in the same piece, forming as it were one single stain, the question of getting rid of these combined stains is in most cases a matter of very considerable difficulty, the oxidized oil retaining the iron stain even against concentrated solutions of oxalic acid or strong sulphurous acid; even the most powerful agent for removing iron stains, a solution of tin oxalates in hydrochloric acid, has not the slightest effect on these compound stains. I may at once say that I do not know of a case of these stains ever being found in gray cloth, or being produced in the course of the bleaching process, although the single oil or iron stains are common enough at this stage. But the compound stain inevitably forms when oil-stained cloth is dyed with an iron mordant. The faintest trace of an oil stain left in the cloth can be found out by treating a suspected sample in a bath of ferrous or ferric sulphate, and producing the well-known iron buff by afterward passing through weak soda carbonate.

As a rule the stain does not show in the buff, but after stripping the color in any suitable acid bath, a bright iron stain remains wherever the cloth retained the least trace of an oil stain. From this it is clear that in the majority of cases these compound stains will never be noticed, unless the cloth is stripped of its dye. Unfortunately the latter process is frequently necessary in the case of drab twills, which have at times, from some unaccountable reason, an awkward tendency to bleach in the folds, or to come up a wrong shade in dyeing. For the purpose of redyeing such pieces the color is stripped and then the oil stains become visible as bright iron stains. On redyeing these pieces in the manner generally used for this class of goods, by first giving two ends in a mixed bath of fustic, sumac, and annatto, and afterward fixing in a bath of ferrous sulphate, these iron stains do not disappear, but show as ugly olive patches. That these stains show only in the second dyeing is easily accounted for, as they now contain twice as much iron as the rest of the piece. It is therefore evident that, before redyeing pieces stained in this manner, it is absolutely necessary to first remove these stains. I have already mentioned the obstinacy with which these stains resist all ordinary agents, and the cause of this, no doubt, is that we have the iron here in the form of an iron soap. Taking this into consideration, there is no doubt that the iron stain will only yield if treated with an agent which at the same time loosens the oil stain. After a great many experiments I found that by padding such pieces in a hot solution of one part of soft soap, one part of glycerine, and three parts of water, taking through squeezing rollers, letting lie for 24 hours, then washing, the iron stains, together with the oil stains, are completely removed. The *rationale* of the process will be readily understood if we remember the great ease with which oils of every description dissolve in solutions of glycerine and soap, and also the capability of alkaline glycerine solutions to dissolve ferric oxide in large quantities. The price of the process amounts to about 3s. per 100 lb. of the cloth, and from this the price per piece may easily be calculated, the weight of a piece varying from 26 to about 80 lb.

The whole difficulty about these compound stains would of course best be dealt with by taking care to remove every trace of oil in the cloth in the keiring process, but as I have already remarked, this is a matter of considerable difficulty in the case of mineral oil stains, although pressure keirs are, as a rule, fairly efficient in this respect. From experiments carried out on a large scale, it appears, however, that this difficulty can be overcome by deliberately increasing the mineral oil stain in the gray cloth, by adding a vegetable oil to it. Treatment even in an open keir is then quite sufficient to remove every trace of an oil stain.—*Weber in the Jour. Society of Chemical Industry.*

TOBACCO AND THE TOBACCO HABIT.

By M. JULES ROCHARD, of the French Academy of Medicine.

THE use of tobacco prevails throughout the whole world. Smokers alone are numbered by hundreds of millions. A million and a quarter acres of the earth are devoted to the cultivation of the plant, and the taxes on it alone in France amount to three hundred million francs (or sixty million dollars). A custom so general, a habit that has been maintained so long in the face of constant attacks upon it, should be considered seriously. It should be studied from every side, and the various elements of the question should be subjected to a complete analysis by the means of investigation now at our disposal, for it is a scientific problem of the first order. While it is of moral and philosophical interest, and its social consequences are within the province of economists, it is for science, physiology, and hygiene to furnish experimental data as the basis for their deductions.

A proper study of the subject should be made with an independence of prepossession which is not easy to find. Persons who have never smoked will talk of tobacco as the blind talk of colors; smokers have a fondness for their habit, while those who have been obliged to give it up are prejudiced on the other side.

I am one of the reformed smokers. After having abused tobacco for about fifty years, I was compelled to abjure it. I fought my ground inch by inch, and yielded only to an absolute necessity. Knowing what the reformation cost me, I have not tried to make proselytes; but I intend to say what I believe is true upon a question which I have studied well, and on which I am not lacking in personal experience.

The tobacco plant belongs to the order *Solanaceæ*, and constitutes a genus (*Nicotiana*) named after Jean Nicot. It is cultivated through the whole world, and succeeds equally in the temperate zone and the intertropical regions. Two species are cultivated: common or large tobacco (*Nicotiana tabacum*) and small tobacco (*Nicotiana rustica*). The first species is the most widely diffused. It is a large and fine looking annual plant, growing to a height of about six feet. It bears large alternate leaves of a glaucous green color, and is tipped with a cluster of elegant flowers having a pale rose corolla and a persistent five-parted calyx. Small tobacco does not exceed twenty inches or two feet in height. Its leaves are thick, soft, dark green, and viscously hairy. The terminal inflorescence comprises clusters of flowers composed of cymes. The pale yellow corolla, a little greenish, is supported by a campanulate calyx, covered with glandular hairs and terminating in uneven teeth. The genus *Nicotiana* includes some fifty other species, mostly natives of America, but some of Australia and the islands of the Pacific Ocean. Of these, some fifteen or twenty species are cultivated and give rise to different foreign tobaccoes, the taste and properties of which are varied. A few species, remarkable for the richness of their colors and their graceful growth, are cultivated as ornamental plants in gardens.

Tobacco leaves contain principles common to all vegetable substances—such as starch, cellulose, sugar, organic acids, and salts—principles soluble in ether, nitrogenous substances, and a peculiar alkaloid to which the plant owes its special qualities, called *nicotine*. This alkaloid, discovered by Posselt and Remann, was isolated by Vauquelin in 1809. It is an oily liquid, transparent and colorless, which becomes brown and thick in the air by absorbing oxygen. Its acrid and virulent odor is like that of tobacco; it has a burning taste, and its vapor is so irritating that breathing is painful in a room where a drop of it has fallen. It is very hygrometric, and soluble in water, alcohol, and ether. It combines directly with acids, with the evolution of heat. It is found as a malate in the leaves. The different kinds of tobacco do not contain the same quantities of it. The black, unctuous tobacco of the Antilles, the pronounced savor, ready burning, and white ash of which make it in demand among experienced smokers, contains much more nicotine than the light, fragrant tobacco of the Levant. The quantity of it increases with the development of the plant, and varies according to the thickness of the leaves. The thinner-leaved plants contain less of it. The fermentation to which tobacco is subjected in manufacturing volatilizes a part of the nicotine and substitutes ammonia for it. Consequently, there is less nicotine in tobacco prepared for consumption than there was in the dry leaves before the preparation. Combustion destroys about three-quarters of this. According to M. Pabst, the smoke of five grammes of tobacco yields about three milligrammes of nicotine; but it contains a number of other principles besides, the enumeration of which here would not be interesting. Nicotine is the active principle of tobacco, as atropine is of belladonna and morphine of opium; but there are other poisons among the substances united with it. The less volatile ones condense during combustion, and produce a brownish empyreumatic liquid, a kind of coal tar of tobacco, a part of which oozes through porous pipes, and the whole of which is retained in the water of nargilehs.

Among the volatile principles that pass into the smoke along with nicotine are hydrocyanic acid and carbonic oxide. Dr. Grehant has shown that a notable quantity of them is absorbed by rapid smokers swallowing the smoke, and the gas passes into the stream of the circulation. These facts are of considerable importance in view of practical consequences, and go far to explain the accidents that sometimes occur after one has passed several hours in a medium saturated with tobacco, even without smoking, and the phenomena of intoxication which are produced by eating food that has remained for a long time in a similar atmosphere.

Tobacco is a poison, as are most of the *Solanaceæ* and many plants which medicine daily utilizes. Its properties have been studied in our time with all the rigor of the experimental method, verified by clinical observation. We can no more than present the principal results of the investigation here. The decoction of tobacco destroys animal life in a time short in proportion to the strength of the dose. The phenomena preceding death are like those produced by other toxic alkaloids, and are identical with those exhibited by man in a similar condition, which doctors have had too frequent occasion to observe. Sometimes convicts or sailors swallow their quids, or fools drink on a wager a glass or two of the empyreumatic juice that flows from old pipes, or the poison is swallowed by mistake, as when snuff is taken for coffee or tobacco leaves are mixed with orange leaves. Cases of malicious poisoning are more rare; but the poet Santeuil died, according to Merat, in horrible suffering after having drunk a glass of wine in which Spanish tobacco leaves had been put. Mortal poisoning is, however, rarely brought about when tobacco is taken by the mouth, for it is nearly always rejected by vomiting before it can produce its worst effects; but the results of intestinal administration are different. The intoxication is then most usually the result of a medical error. The decoction of tobacco is still given sometimes as an injection in cases of asphyxia by submersion or of strangled hernia, and, if the dose is too large, death may result. Orfila cites four cases that were fatal in doses ranging from eight to sixty-four grammes. One patient died in fifteen minutes, and the one who held out longest at the end of two hours. Eight grammes do not form a toxic dose, but the case cited by Orfila was one of an infant. From fifteen to thirty grammes are required to kill an adult. Tobacco may also poison through the lungs. Cases are mentioned of persons who died from sleeping in a room filled with fermenting leaves; others, worthy rivals of the bettors just now spoken of, died after executing wagers that they could smoke an improbable number of pipes without intermission. The skin itself may serve as a channel for the introduction of the toxic principle. Accidents of this kind were not rare when diseases of the skin were treated with pomades or liniments of which tobacco was the base. Murray reports an observation of three infants who were taken with vomitings and vertigos, and died in convulsions within twenty-four hours after having their heads rubbed with a tobacco ointment. Cases are recorded of smugglers who died after having covered the bare skin of their bodies with tobacco leaves which they were trying to introduce fraudulently. Ferdinand Martin has related the case of a lady afflicted with lumbago who applied flannels dipped in a decoction of smoking tobacco to the ailing part. Her pains were promptly subdued, but she soon felt all the phemonena of intoxication by nicotine, and did not recover from it for three days. Poisoning by tobacco generally occurs by accident or mistake. It is rarely tried criminally, probably because the toxic properties of the drug are not reliable enough. Assassins prefer the alkaloid itself, the effects of which are much more prompt and more terrible than those of the plant. By whatever method it is administered in experiments, the animal is slain. Two drops are enough to kill a large dog; eight drops will kill a horse in four minutes. Under its effects he rages, prances, writhes, falls down, and dies in convulsions. "This alkaloid," says Claude Bernard,* "is one of the most virulent poisons known, and a few drops of it on the cornea of an animal will kill it instantly. Nicotine, apparently sympathetic in its effects, in its action is very much like prussic acid." The action of this principle is so subtile that it cannot be analyzed unless the drug is administered in minute doses and very dilute solutions. There is then observed the phenomenon—which goes far to explain the facility with which one is habituated to the use of tobacco—of the rapid development of tolerance of gradually increasing doses. This has been demonstrated by Traube, who, with the twenty-fourth of a drop of nicotine subcutaneously injected, obtained very marked effects on the first day. The next day, on the same animal, it took a whole drop to reach the same result, and at the end of four days five drops were necessary. A similar tolerance is observed in man for hypodermic injections of morphine; but one does not get accustomed to digitaline or strychnine.

When nicotine is administered in doses weak enough to permit an analysis of its effects, almost the same phenomena are witnessed as with the whole plant. In the cases of poisoning already mentioned, there came on at the beginning extreme anguish and agitation, with sensations of burning heat in the pit of the stomach. Respiration was accelerated and the pulse was slackened; then came vomiting and purging, vertigo, and faintness. The face grew pale, the skin was covered with a cold sweat, the head was confused, and the patient fell into a deep stupor, with cries, general trembling, and convulsions. This agitation gives place to paralysis and insensibility; respiration is impeded, the pulse declines to a mere thread, and the patient dies in syncope.

When the patient resists the attack, as is most frequently the case, the evolution of the symptoms described above is arrested, and the sufferer comes out of his comatose condition with a violent headache, extreme weakness, and a gastric disturbance which it requires a considerable time to allay.

The effects produced by the habitual use of tobacco differ according to the way it is consumed. They have not been much observed except among smokers, who are most noticed because of their number. Then their habit is open: the smoke goes everywhere, and it causes inconvenience to others; while the more discreet snuff taker can hide his snuff box, and annoys with the smell of tobacco only those who come too near him.

Beginners at snuff taking require, like smokers, an apprenticeship. They begin by sneezing; then the mucous membrane of the nasal fossæ becomes accustomed to the drug, is palled, and even finds itself pleasantly tickled by the ammoniacal piquancy and nicotian perfume of the virulent powder. At last it becomes thick, and with intemperate snuff takers perceives odors only feebly. It becomes sometimes the seat of a chronic inflammation which extends to the pharynx and produces a slight dry and characteristic cough. Snuff takers are told of who have suffered from eruptions, ulcerations, and polypi; others have

* Lecons sur les effets des substances toxiques et medicamenteuses, Paris, 1857, p. 397.

become deaf; but such cases are so rare and their etiology is so doubtful that serious account need not be taken of them.

The only phenomenon peculiar to nicotine often observed among snuff takers is a rhythmic trembling of the hands, not like that of old men or that of drunkards, but which is observed likewise in excessive smokers. A single case is mentioned by Dr. Bean of *angina pectoris* in a patient who was addicted to an excessive use of snuff. But a solitary case is not important in the consideration of a habit so general, and there is no need of pursuing a fugitive enemy. Snuff taking is condemned by fashion, from whose decrees there is no appeal. Those of hygiene are not so imperative.

Smoking is charged by its opponents with injuring the health and debasing the mind. The former part of the charge has a measure of foundation. There is certainly nothing hygienic in the habit. All are acquainted with the troubles that ensue on the first effort to smoke. There are nauseas, soon followed by vomiting, headache, vertigo, and a condition resembling sea sickness, and much like the earlier phenomena of acute poisoning by tobacco. These troubles soon pass away, and after a few succeeding efforts the smoker accustoms himself to the action of the smoke. When the habit is once acquired, smokers feel no further inconvenience; and there are some who are able to smoke just before sitting down at the table. Smoking generally dulls the appetite and gives relief against the pains of hunger. But after eating the desire to smoke becomes irresistible. This is the psychological moment; and the pleasure we feel then is more intense than at any other time in the day. The pipe or the cigar is a condition of good digestion for some smokers, but in others it produces gastric troubles. Nervous people, those who lead a too sedentary life, and office men, especially if they have the habit of smoking before meals, gradually lose their appetite, and acquire instead of it a painful anxiety and nausea. Others suffer from pyrosis. There are smokers who cannot light a cigar at some hours in the day without having the feeling of hot iron that marks that affection. Nearly all excessive smokers are dyspeptics; and the fact is explained by the excess of salivation and the diminution of the gastric juice and of the functional energy of the stomach. Next after the digestive troubles, the most common affections touch the respiratory organs and the heart. Granular pharyngitis is very common among persons who smoke to excess The irritation of the pharynx is often communicated to the larynx, and there results a peculiar dry cough. Others feel a temporary oppression in the evening after having smoked during the day. A special form of asthma has been mentioned as caused by the abuse of tobacco; but cases of it must be very rare, for I have never observed it, though I have passed my life among smokers. Affections of the heart are more frequent. Some doctors assert that one-fourth of the smokers are afflicted with palpitations and irregularities of the pulse. I do not know where such observations have been made, but I have never seen any cases of the kind. I, as well as other doctors, have met cases of *angina pectoris*, chiefly among persons who passed their lives in an atmosphere saturated with tobacco, and among those who have swallowed the smoke of their cigars, and have not been surprised at them, because the smoke then enters into the lesser ramifications of the bronchial vessels, where it impresses directly the finest nervous threads of the lungs and the heart, and its action induces the spasms of suffocation that constitute that terrible disease. These symptoms are at first fleeting, and rarely mortal; but, if the patient does not abandon his habit, they occur more frequently, and become more grave till death ensues in one of them. Disasters from breathing an atmosphere saturated with tobacco smoke seem more liable to occur with children than with grown persons. Staying in smoking rooms, where the smoke is sometimes so thick that one can hardly see from one end of the room to the other, is dangerous to persons subject to palpitations, even though they do not smoke. Dr. Vallin has cited three facts conclusive as to this point, one of which relates to the case of a young officer who had given up tobacco three months before, and was attacked with a suffocation like *angina pectoris* after having passed several nights in his room, where his friends came to smoke for some hours every evening. Dr. Gelineau tells of an epidemic of *angina pectoris* among some sailors who were crowded in the between decks of a merchant vessel during a storm that made it necessary to close all the hatches, and who smoked to pass away the time. Those who did not join in the smoking suffered equally with the others, for they breathed the same toxic atmosphere.

Pipe smokers are in danger of epithelioma, or cancer of the lips and of the tongue. The former occurs chiefly among persons who smoke a very short-stemmed clay pipe. Smoker's cancer appears usually at the point where the hot pipe stem bears upon the lower lip, and on the side of the tongue at the point where the smoke touches at each aspiration. In some cases it begins with buccal *psoriasis*, a kind of thickening of the epithelium of the tongue, which becomes white, glossy, and horny. These two forms of a horrible malady are incontestably the most serious danger smokers incur; and the fear of it is the motive that has impelled the majority of conversions from the habit. The frequency of them should not, however, be exaggerated.

Tobacco has been accused of contributing to the depopulation of the country by enfeebling the reproductive powers of men and inducing miscarriages in women. The former part of the charge is founded on the very real fact that the smoking of tobacco, while its influence prevails, appeases all ardor; but its action is essentially temporary, and does not detract from the general powers of smokers. Their families are as numerous as those of other persons, and the peoples who smoke most are precisely those who have the most children. The Germans smoke twice as much as the French, and have five times as many children. The possibility of tobacco promoting abortions is more open to discussion, but it cannot exert any noticeable influence on the movement of population, for it concerns only a very limited class of women—those who work in tobacco factories. These establishments have borne a bad reputation in the past, and the effect of life in them upon the operatives has been painted in very dark colors. All manufactories were until recently in a deplorable hygienic condition. Now the rooms are spacious and well ventilated, and all precautions are taken to preserve the health of the operatives.

But, whatever may be done, the vapors of nicotine cannot be got rid of in the shops where large quantities of tobacco are dried and fermented, or where it is stored in bales and casks. When the leaves are cleaned and mixed, in rasping and grinding, dust as active as the vapors is diffused around. Operatives who work in this atmosphere are in the situation of smokers, and become habituated to it after having suffered the same disorders in the beginning. Those who work in smaller and insufficiently ventilated rooms are often more seriously affected; but, as a rule, these workmen enjoy good health. Opinions as to the particular effect of this employment on women differ; but the prevalent result of the discussion appears to be that tobacco does not provoke abortion, and has no mischievous influence on the health of women operatives. Abortion is not more frequent among them than among other working women: and the weakness and mortality of their children are easily explained by the fact of their being left at home while their mothers are at the shop.

Among the maladies to which hardened smokers are exposed is nicotinic amblyopia, which Sichel noticed first, and which has been well studied by modern ophthalmologists. It is a peculiar weakening of the sight, and is distinguished from other affections of the kind by the readiness with which it passes away when the patient gives up tobacco, and the promptitude with which it appears again when he resumes the practice. It is very rare. So is a paralysis which has been observed in Germany. Delirium tremens, convulsions, epilepsy, hallucinations, dementia, precocious senility, and melancholia have been mentioned as among the evils brought on by tobacco. No doubt smokers have them, and many other diseases. Tobacco will not save them from any of the ills with which mankind is afflicted.

Of all the accusations that have been made against tobacco, that of blunting the intellect is the most cruel to smokers. But the evidence in favor of it is not formidable. That most frequently encountered is obtained from statistics that show that in institutions for public instruction smokers stand lower in their classes than other pupils. Decaisne has shown this for the French lycees; MM. Bartillon, G. Dore, and Elie Joubert, for the pupils of the Polytechnic School; and Dr. Coustan, for the Normal and Naval Schools and the School of Bridges and Roads. The demonstration is hardly satisfactory. It seems reasonable to assume that the smoking pupils do not succeed so well as the others because they are idle and find in tobacco an auxiliary to their indolence and a relief from its consequent *ennui*. Probably, if the investigation had been pushed further, it would have been found that the same pupils are those whose general conduct leaves most to be desired, and who are most frequently punished. Discussion of this charge brings up an international comparison that is not favorable to its validity. There is a people north of the Rhine, whom I have already mentioned, and with whom the use of tobacco has almost become an institution. They consume a half more than we (the French), and yet we have to admit that these Germans are not as dull as they should be by the theory, that they do not cut a bad figure in the scientific world, and that they hold a preponderant position in Europe. A more specious argument than this is one which the detractors of tobacco draw from the enfeeblement of memory which many observers pretend to have remarked. This would be a serious matter if the charge were sustained; but it does not appear to me proved. Instances have been related in good faith, it is true, of persons who are supposed to have lost their memories through the use of tobacco; but my impression is that the loss can be more properly attributed to advancing age.

I have no thought of writing an apology for tobacco, or of asking for the erection of a statue of Jean Nicot. Smoking is a bad habit for everybody, especially for women and children. But because tobacco is a grand culprit is a reason why it should not be painted blacker than it is. If we exaggerate its faults and attribute imaginary ones to it, we run the risk of wholly missing our aim. In fact, children whom we are trying to preserve from it, when they see smokers around them able bodied and sparkling with wit, are disposed to think we are deceiving them when we hold up this bugbear before them, and will come to not believing the real evils of the bad habit against which we are trying to fortify them.

Last to be considered is the philosophical side of the question: What is the motive that impels so many persons to contract an inconvenient, expensive, and unhealthy habit? The problem is insoluble to persons who do not smoke. "I can never comprehend," lately said a professor of hygiene, "the enjoyment one can feel in converting his mouth into a chimney flue." Dupuytren called the habit of smoking the ignoble pleasure of poisoning one's self and others. This is not surprising; but it is more so that smokers themselves cannot account for the fact. The general opinion is that we begin to smoke to imitate others, and continue it by habit, as a distraction, or means of dispelling *ennui*. "The boy of fourteen or fifteen years, beginning to smoke," says M. Dumas, "does not seek a cerebral excitement in the new habit any more than one who is beginning to drink. He simply imitates the bearded persons whom he sees with the pipe or cigar in their mouths. It is to him one of the signs of the virility to which he aspires. It is the easiest way for him to make himself believe that he is already a man, and to make the public believe it." This is true, but few smokers can find any traces of this feeling in their recollections; but while the desire of affirming one's virility and doing like others may explain the first essays in the face of the pains that attend them, it does not account for the irresistible attraction of the habit once formed and the readiness with which it establishes itself. The customs and tastes of populations and the fashions change and give place to others that disappear in their turn, after having inspired the same infatuation in us; but the habit of smoking goes on increasing, over all obstacles. The earliest adepts of the practice braved anathemas and persecutions, and some of them punishments. The smokers of to-day do not have to make the same struggles, but many of them endure troubles that compromise their health rather than abandon the practice, and among these are men of energy and intelligence, whatever else may be said of them.

There must, therefore, be in this passion something besides the satisfaction of a mechanical habit. "The particular intoxication caused by tobacco," says M. Dumas, "must have irresistible attractions for an intoxicant of so recent discovery, the initiation into which is so painful, to have overtaken wine, old as the world." The charm of tobacco intoxication is not easy to explain. It is in the soothing, says M. Fay; it is an anæsthesia that has become necessary, says M. Richet; it is a state of torpor which conduces to revelry, say others. Tolstoi maintains that it is nothing of this kind, but the desire to stifle the voice of conscience; and, confounding tobacco with alcohol and opium, the Russian romancist envelops them both in the same anathema. In explanation of his view he has recourse to a theory known in physiology as that of duality, or human dynamism. During his conscious life, Tolstoi says, man has frequent occasion to recognize in himself two distinct beings: one blind and sensitive, the other enlightened and thinking. The former eats, drinks, rests, sleeps, reproduces, and moves, like a machine wound up for a certain time. The other, the thinking and enlightened, united with the sensitive one, does not act by itself, but only controls and appraises the conduct of the former one, helping it effectively if it approves, and remaining neutral in the contrary case. This spiritual but powerless being plays in human psychology the part of the compass of the ship, of which the other being is the helmsman. The last can follow the directions of the magnetic needle, or he can pay no attention to them; he is even able, when its warnings annoy him, to disarrange his compass. Weak and timorous persons have recourse to the last expedient. They stifle their conscience, and, in order to do so, use alcohol or tobacco.

Count Tolstoi's theory cannot be sustained. It has one particularly weak point in the similarity which the author assumes between the effects of tobacco and of alcohol. Not one of the personages whom the translator of his work consulted protested against this confusion, and still it is false and deceitful. The Russian's paradox may be applied, to a certain extent, to drunkenness. We do sometimes get drunk to forget to stupefy ourselves, and it is a detestable means. Rogues and criminals all do it; they drink often to give themselves heart, murderers especially; while there is not a case known, as M. Aurelian Scholl has observed, of a crime committed with pipe or cigar in the mouth. The author himself confesses that he dulled his conscience with tobacco for a long time. It had not, it is true, many reproaches to address to him. Sometimes it reproved him for idleness, or admonished him for a neglect, or a want of punctuality, or an excess of passion in which he had not measured his tone. To quench his remorse he lighted a cigar, and all was forgotten. If tobacco had never committed worse misdeeds, nobody, I believe, would have thought of quarreling with it.

Other modes of voluntary intoxication have the common characteristic of deranging the reason and the moral sense. Hashish produces hallucinations and delirium, and plunges persons into a condition like madness. Opium puts to sleep, and procures for some persons agreeable dreams; but one becomes quickly habituated to it, the doses have to be increased, all the functions flag, and the opium smoker falls into a condition of inanity, at times interrupted by fits of homicidal furor. Morphinomaniacs do not suffer the same perversion of mind, but they become false, dissimulating, indifferent to all that is foreign to their passion, extending to family feeling and even to honor. Their health is injured more quickly than by opium smoking, and their life is shortened as much. Alcoholism is still worse. I have studied its effects in all their phases in another work, and will not repeat my conclusions now. It is sufficient to recollect that the ignoble and degrading vice attacks nations in all their vital forces; families in their honor, fortune, and prosperity; that it peoples hospitals, insane asylums, and prisons; and costs France a milliard and a half of francs a year.

Tobacco can be reproached with no such mischief. It has never led the reason astray, destroyed the will, or perverted the sensibility of any one. The most hardened smoker enjoys at all times the most perfect clearness of mind. Even at the moment when he is under the influence of nicotine he talks, reasons, studies, and works with a freedom of thought that proves that his intelligence has not received any harm. One might say that tobacco had disengaged him from physical impressions, and that, as Dr. Richet says, it mollifies the sensibility of the organs only to leave the psychical functions greater freedom of evolution.

There is another characteristic difference between tobacco and other voluntary poisons. A person can break up the habit of using tobacco, while alcoholism and morphinomania are almost incurable. At the end of my long career I cannot recollect having witnessed more than two or three cures from alcoholism, and I cannot affirm that they would have been permanent if the subjects had been exposed to new temptations. Morphinomaniacs are absolutely incurable unless they are interned. Smokers, on the other hand, can correct themselves when they wish to. They only need a firm will. We see persons every day who have done this; and since the troubles caused by tobacco have been more definitely known, we see many men giving it up of their own accord as they advance in age. The habit is so completely lost that after a few years the reformed victim can find himself in a company of smokers without feeling a desire to imitate them; and if he is moved to light a cigar, he will not find the pleasure of the old days in it.*

I might stop here; but I will not finish this article without giving my own explanation of the fascination of tobacco. It is probably no better than the others, and I will not try to impose it on any one.

Men have at all times eagerly sought for substances that would act on their nervous system. The tendency

* The translator of this article was an inveterate smoker till the summer of 1868. One evening he said to himself that he would not smoke that evening. That is all the resolution he ever took; but he has never smoked or desired to smoke since.

is general, and is exclusively human. To escape real life and the drudgery of daily occupations, to live in dream land, in an ideal world which the imagination can people at its will, and can embellish with its illusions, have irresistible charms to some minds. In obedience to this dangerous seduction they involuntarily seek the dreams of opium and hashish, the intoxication of ether and chloral, or the grosser drunkenness of alcohol. The weak yield unresistingly to their inclination, and pass into the degrading excesses which I have reviewed. Tobacco offers no such seductions and is attended with no such dangers. Its action on the nervous system is weak and wholly special. It does not put to sleep, but it calms and mollifies the sensibility of the organs. It causes an agreeable torpor, during which thought continues lucid, and the capacity for work is not diminished. Such is the attraction it exercises, and which causes it to be sought for by so many thinkers and students. Tobacco is to them a help in mental labor. When fatigue begins and the need of a moment's rest is felt; when the thought fails to present itself with the usual exactness, and the mind hesitates over the shape to give it, the student, writer, or investigator stops, lights his pipe, and soon, by favor of this pleasant narcotic, the thought appears clear and limpid through the bluish cloud in which the smoker has enveloped himself.

I should make a wrong impression if I left it to be believed that I thought tobacco necessary to mental labor. It becomes so only for those who have contracted the habit of using it, and they can divorce themselves from it without losing their capacity. As a whole, tobacco is harmless to the mind, but it may have a mischievous influence on the health, and may cause serious diseases. We should not advise any one to use it, and should try to keep women and children from doing so. In taking up this part of its programme, and in affiliating itself with teachers of all grades, the Society against the Abuse of Tobacco has performed real service; but it has tried to gain its end by exaggerations that can only compromise it. It is of no use, and would be labor lost, to try to convert adult smokers so long as they experience no inconvenience from the habit. As soon as they begin to feel some troubles, and have reached an age when the troubles may become grave, the dangers to which they are exposing themselves should be described to them without extenuating them, but without making the picture blacker. If dangerous affections are threatened, like *angina pectoris*, or injuries to the tongue and lips, a decisive course must be taken, and the immediate and complete abandonment of the cigarette and pipe insisted upon, for experience has taught that there can be no gradual leaving off.—*Translated for The Popular Science Monthly from the Revue des Deux Mondes.*

ALPINE GARDENS.*

THE first alpine gardens were suggested by the sight of torrents which, dried up during the summer, and rolling heavy rocks at the time of the melting of the snow, have their steep banks covered with a multitude of charming plants during the fine season. This idea should not be lost sight of by him who undertakes such a work, and the result will be so much the better in proportion as it more accurately reproduces the natural scenes observed. If he has the spirit and leisure for it, the artist should go to seek the combinations that satisfy the eye from all points, *in situ*, note the form and dimensions of each rock, the relative positions of the plants that cover or surround it, and fix each of these details by an accurate sketch or by photography. The art will afterward consist in grouping these different scenes, the union of which will form a perfect whole.

As picturesque effects are obtained by a skillful imitation of nature, it will be necessary to combine them with the exigences of culture. The amateur should, therefore, possess taste and a certain amount of horticultural knowledge; otherwise, it will be well for him to ask advice of a landscape gardener. The first condition to be fulfilled is to give sufficient nourishment to the plants that are to embellish the rocks. In most cases failures are due to no other cause than an insufficient preparation of the soil. Although some species, like the orpines (*Sedum*), the house leeks (*Sempervivum*), the saxifrages, etc., live upon the bare rock, the great majority of alpine plants seek deep earth and develop roots therein several feet in length, such as the *Silene alpestris* and *acaulis*, the various pinks (*Dianthus alpinus* and others), the globe daisies (*Globularia cordifolia*), etc. Let us remark, by the way, that horizontal fissures, such as shown by No. 1 of Fig. 1, are not, as a general thing, favorable to the culture of alpine plants. When superposed rocks are used, it will be well to spread a good layer of suitable soil over each of them before placing the succeeding one, and to maintain the necessary spacing by fragments of hard stone, such as basalt or granite (No. 2). In most cases it will be preferable to form oblique or vertical fissures between the rocks, but care must be taken that the upper rocks do not overhang. A plant placed at the entrance of the fissure, H, as shown by No. 3, will receive the sun and the rain, while placed at K (No. 4), it will soon perish for want of light and moisture.

A satisfactory form for the establishment of ragged rocks is that shown by No. 5. The rain falls successively upon each stone and infilters into each fissure and reaches the bottom of it. For the same reason, it is well to cover the upper part of the work with earth and small stones (No. 6), to the exclusion of large rocks, unless, however, it is desired to produce a definite picturesque effect.

The vertical fissures, which are those best adapted to alpine plants, should, as far as possible, be narrower at the bottom than at the top. Were it otherwise the case, the earth would leave the side walls through the effect of rain, and accumulate at the bottom. Care should be taken to place a few loose stones at the upper part of the fissure in order to prevent too rapid an evaporation.

As for the general arrangement of the rocks, one of the best is that offered by No. 7. Many alpine plants are particularly partial to narrow clefts that receive the sun for several hours, but that are protected from its rays until about noon by a line of higher rocks. In fact, a shelter against heat is still more necessary in the morning than in the afternoon. The plants exposed to the last are dried up at a very early date during the summer, while the dew remains until noon upon those that are exposed to the west (or to the north, and sheltered toward the east).

No. 8 of Fig. 1 shows how, in a western exposure, plants placed in the fissures, F F, are protected against the morning heat of the sun by the rocks, R R, forming a screen. Upon the whole, the exposures that should be selected for the culture of alpine plants are the western and northern ones, provided that, in the latter case, they are sheltered toward the east.

In certain cases, one will be led either to make use of some already existing wall, or to construct one, to sustain the earth. The following is at once a practical and picturesque manner of utilizing such a wall for the culture of alpine plants and especially of alpine shrubs, for many small species prefer to be grown upon the narrow sides of the rocks (No. 9).

A width of about 24 in. is given the base of this wall, and a height of 20 in. above the surface of the ground.

The two sides, which must be made of rubble, should have a space between to be filled in with carefully prepared earth. Finally, the whole is covered here and there with large blocks of stone to assure the stability of the structure.

The cement joints are suppressed here and there, and replaced by earth, and it is into these interstices that are introduced the roots of the alpine plants whose stems will cover the face of the wall. Finally, in order to increase the picturesque effect, a certain number of pockets are formed irregularly in the exterior for the reception of ferns, ivies, pinks, linarias, house leeks, etc.

In order to give variety to a rock garden, we may mingle with the blocks of stone, trunks of trees head downward, and raising in the air their variously twisted roots. In the natural pockets formed by such roots may be planted species of quick growth, such as certain campanulas and other plants that particularly prefer such a medium, as, for instance, the columbines, some of the large compositæ, some of the umbelliferæ, etc. The whole may be interlaced with clematises and brambles, and ivies with foliage variegated with red, yellow and white, so as to form an *ensemble* most agreeable to the eye.

An opposition has often been made, and not without reason, to the use of such half-rotten roots, on the ground that they decompose too rapidly, lose their original aspect, and become the refuge of slugs and woodlice. This second part of the criticism is very just, and we could not too strenuously recommend amateurs to wage bloody war on these enemies of pretty alpine plants; but, for the first criticism, there is, in our opinion, less foundation. In the beautiful alpine garden at Kew (Fig. 2), may be seen three trunks planted in 1882, and that have remained intact up to the present.

We have several times remarked that it is necessary to give the plants soil suited to their nature. The best process that can be employed consists in mixing, with the existing soil, vegetable mould, somewhat argillaceous, and compact. Such work will be truly necessary only in soils that are purely calcareous. In most cases, but few amendments will have to be made for the establishment of a rock garden, especially in clay, in which a number of alpine plants grow admirably. We are of the opinion that it will be better for one to devote his attention to digging deeply into the earth so that the roots may easily descend therein and find the moisture necessary for them during the heat of

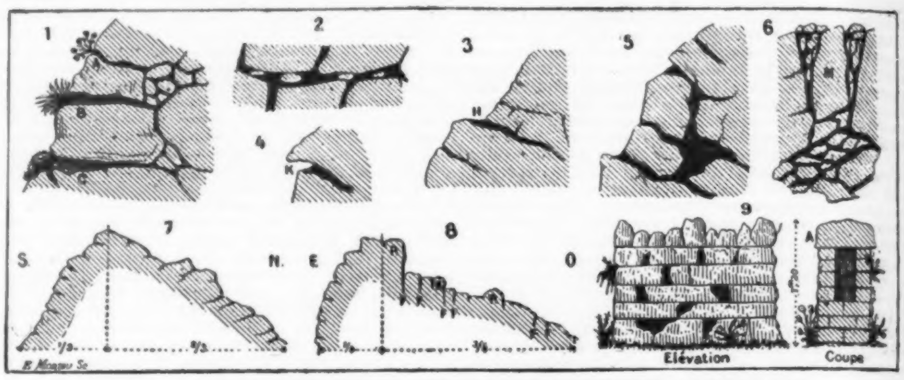


FIG. 1.—ARRANGEMENT OF ROCKWORK IN ALPINE GARDENS.

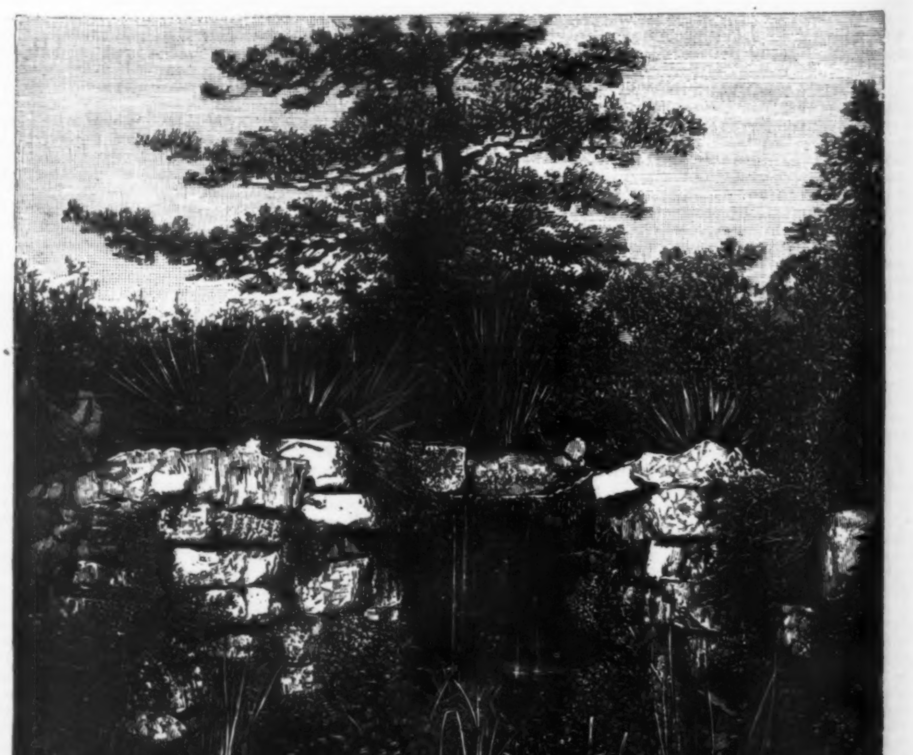


FIG. 2.—ROCK GARDEN AT KEW—CASCADE AND AQUATIC PLANTS.

* The following is a list of plants that may be recommended for cultivation in alpine gardens: *Helleborus niger, H. purpurescens, H. orientalis, H. niger var. angustifolia, H. punctatus, intermedius; Dianthus cæsius, D. alpinus; Primula denticulata; Potentilla nitida, P. cruenta; Rubus arcticus, Veronica Hectorii, V. Traversii, V. pinguifolia; Hedera Helix hibernica, Meconopsis Wallachii; Ramondia pyrenaica; Cornus canadensis; Cistus corbariensis, C. laurifolius; Saxifraga Rocheliana var. caryophylla, S. cochlearæfolia minor, S. cristata; Geranium sanguineum, G. atlanticum; Cotoneaster reflexa, C. rotundifolia; Adiantum Capillus Veneris, Nephrodium rigidum; Gentiana asclepiadea, G. acaulis; Calceolaria plantaginea, C. villosa; Dryas Drummondi, Hydrangea scandens, Helianthemum tomentosum, Scolopendrium officinale; Sedum latifolium, S. rupestre, S. spectabile; Sempervivum tectorum, S. montanum, S. calcareum.*

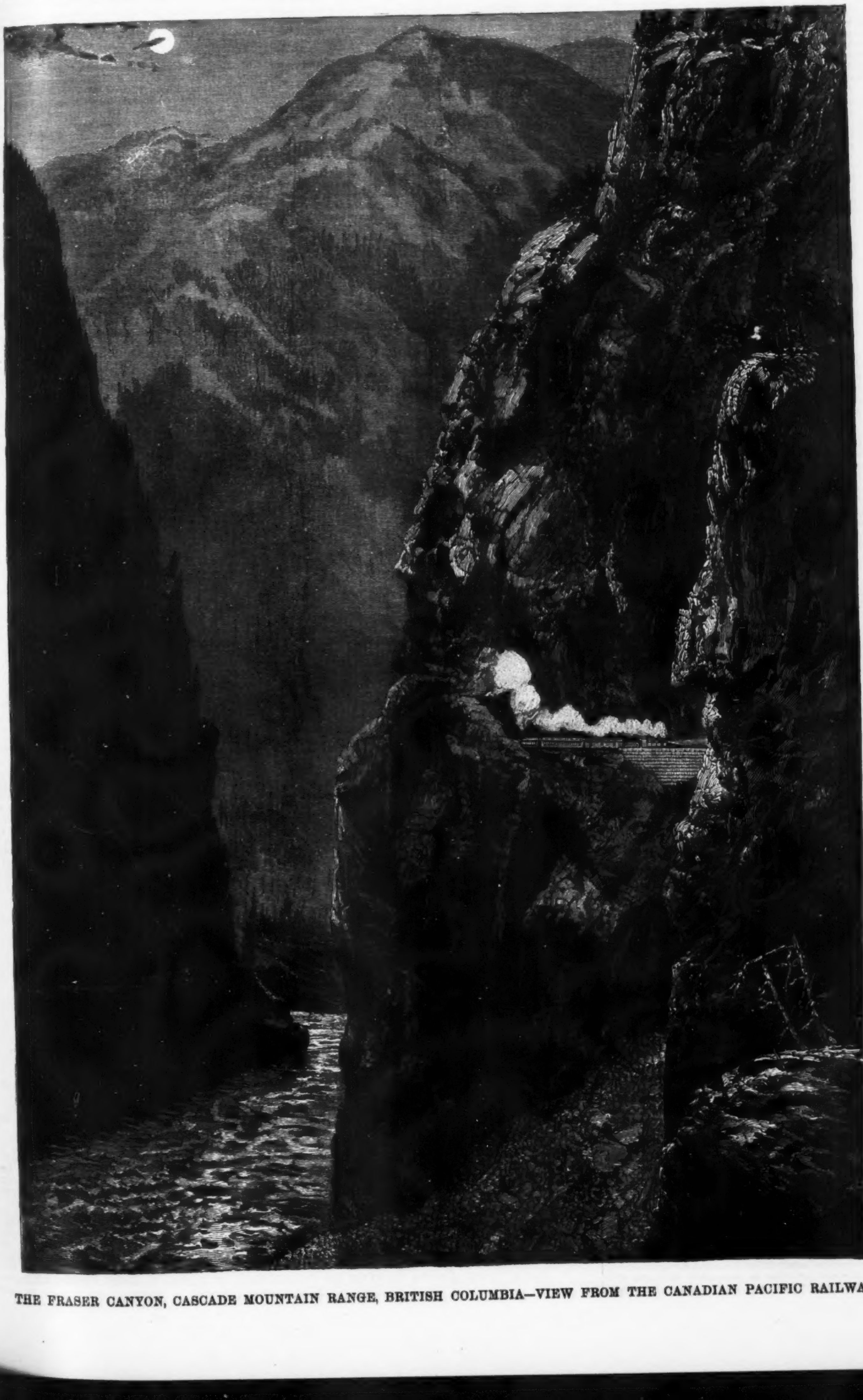
summer. It will be well to form a few pockets of earth from a heath for the species that delight in such soil.

The installation of a perfect alpine garden should be completed by a good system of piping and drainage. The surplus water of irrigation may be allowed to flow into cesspools arranged at the side of the path, which should not be absolutely plane, but have a slight slope, invisible to the eye, but sufficient to assure the flow of the water.—*La Nature.*

THE FRASER CANYON, BRITISH COLUMBIA.

A VIEW of this sublime and romantic scene in the Cascade range of British Columbia, as seen from the Canadian Pacific Railway, is presented in our engraving. The principal canyon or gorge of the Fraser River commences at Boston Bar; between that point and the town of Yale, a distance of twenty-three miles, its aspect is almost appalling by its savage grandeur. The Canadian Pacific traverses the entire length of this canyon, the line being carried along the faces of the cliffs, 200 ft. or more above the river. This is the Fraser Canyon.

At North Bend Station, the railway company has erected a charming little chalet-like hotel, for the accommodation of tourists who desire to explore the canyon. This hotel is situated at a most advantageous point, in the midst of the finest scenery, and visitors will find it a convenient and comfortable place of sojourn.—*Illus. London News.*



THE FRASER CANYON, CASCADE MOUNTAIN RANGE, BRITISH COLUMBIA—VIEW FROM THE CANADIAN PACIFIC RAILWAY.

RUMINANTS AND THEIR DISTRIBUTION.

By R. LYDEKKER, B.A. Cantab.

FROM early times we find the function of ruminating, or "chewing the cud," recognized as a peculiarity of the group of mammals known in semi-popular language as ruminants. Thus, in Deuteronomy, the animals permitted for food are those that "chew the cud and part the hoof;" while the swine, "which part the hoof but do not chew the cud," are forbidden. On the other hand, the camel, which chews the cud but has not paired hoofs, is in the forbidden list. In the permitted animals we thus have a recognition of the group of ruminants as represented by oxen, sheep and deer; of which no better short definition can be given than that they chew the cud and have each foot furnished with a pair of hoofs symmetrical to a vertical line between them. The want of the paired hoofs in the camels, which are also cud chewers, shows, however, that these two characteristics will not hold good for the entire group. As we proceed, we shall find that there are structural features, common to the group, in addition to the peculiarity of rumination; but, before going further, we may observe that the recognition of their paired hoofs, coupled with the absence of rumination, is an exact statement of the relationship of the swine to the true ruminants.

The word "ruminant" comes from the Latin *rumen*, which was applied to both the "cud" and to that part of the stomach in which the latter is contained previous to chewing. The Greeks had a word, *meruko* or *merukizo* (from *meruo*, to revolve), to express this action of cud-chewing, and a derivative from the former was used by Aristotle to designate ruminants, who thus first distinguished the group by a definite name. This early recognition of the ruminants as a group is probably due to their importance to man, the biblical record showing that they yielded the only mammalian food permitted to the Hebrew, and this pre-eminence as a source of food has scarcely decreased to the present day. They are, moreover, now the dominant type of larger mammals, as witness the herds of bison which lately roamed over the American prairies and the droves of antelopes on the African "veldt."

Commencing with the function of rumination, we may observe that it is a remastication of grass or other vegetable food, swallowed almost as soon as plucked, and transferred to a special receptacle in the stomach. From this it is regurgitated into the mouth by a reversed action of the muscles of the throat, and, after having undergone mastication—or rumination—is transferred to the digesting part of the stomach. Now, it is evident that this complicated arrangement, so different from that of other animals, must be of some special advantage to the ruminants. As a matter of fact, these animals, like other large herbivora, are obliged to consume a large quantity of food to obtain sufficient nutriment; and it is obvious that if this food had to be masticated as soon as plucked, the operation of feeding would be very protracted; but by the arrangement mentioned the requisite amount of food can be gathered within a comparatively short time, and the animals can then retire to ruminate in concealment. It is superfluous to comment on the advantage this is to creatures which, like many ruminants, have but little means of defending themselves against carnivorous foes; but we may mention that many still further increase this advantage by feeding only at dawn or evening, when they are far less conspicuous than in the midday glare. There is, moreover, evidence that when ruminants first appeared, this rapid feeding was of more importance than at the present day, since while many of the modern larger forms, like oxen, antelopes, and deer, are provided with formidable weapons in the shape of horns or antlers with which they can keep foes at bay, in earlier times such weapons were either absent or but feebly developed.

Seeing, then, that the function of rumination is correlated with a special compartment of the stomach for the temporary reception of the freshly gathered food, it would be expected that animals thus provided would also possess an efficient masticating arrangement for reducing their food to the condition in which it yields the fullest nutriment. Such, indeed, is the case, the grinding teeth of ruminants being of a complex structure, unknown elsewhere. In our previous article, on "Teeth and their Variations," we have indicated the characteristic structure of the grinding or cheek teeth of the ruminants, and have shown how the last three in the upper jaw (Fig. 1) are composed of four columns,

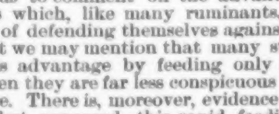


FIG. 1.—THE FIRST UPPER MOLAR AND LAST TWO PREMOLARS OF A RUMINANT.

of varying height, of which the two inner ones are crescent shaped. It was, moreover, shown at the same time how these *selenodont* (crescent-like) teeth could be traced back by gradations to the simpler *bunodont* (hillock-like) teeth of the swine. The lower grinding teeth having their crescents directed the opposite way to those of the upper jaw, and both upper and lower teeth consisting of layers of different hardness, we can scarcely imagine a better masticating machine than is presented by the opposition of the two series of grinding teeth of these animals. Bearing in mind this structure, the definition of cud-chewing, selenodont mammals will suffice to distinguish the ruminants from all other animals. When, however, we say that these characteristics distinguish them from all other animals, it must be added that this refers only to those of the present day. We have already seen how the Mosaic law recognized the similarity in the structure of the hoofs of the ruminants and the swine, and it is curious that while under the Cuvierian system of zoology these two groups were widely sundered, modern palæontological researches have shown that they are really closely related, the want of the power of chewing the cud, with the correlated absence of the selenodont structure of the teeth, being the chief essential features in which the latter differ from the former.

Here a curious problem is presented to those who put their faith in a mode of evolution dependent only upon so-called natural causes, in that it is impossible to give any adequate explanation of what possible advantage would be the development of an incipient selenodont structure in the teeth of the early swine-like ungulata, or at what precise stage the function of chewing the cud, with the concomitant development of a separate compartment in the stomach, was superadded to the normal mode of feeding characteristic of the swine.

Here we must say a few words as to the structure of the ruminant foot. The "cloven hoof" of ruminants and swine has become such a proverbial expression that the idea may linger that this is due to the fission of a single hoof, like that of a horse. As we have endeavored to show in our article on "Rudimentary Structures," nothing could, however, be further from the truth; the two hoofs of a ruminant (Fig. 2) corresponding to the terminal joints of our own middle and ring fingers (or the corresponding toes), which are the third and fourth of the typical series of five. The lateral or spurious hoofs (not shown in Fig. 2) of the

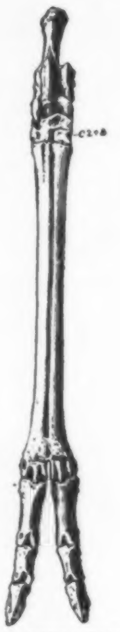


FIG. 2.—BONES OF THE HIND FOOT OF A RUMINANT.

The letters indicate the lower bones of the ankle. (After Osborn.)

ruminants represent our own index (2d) and little (5th) fingers, or toes. It is a further peculiarity of the true ruminants and camels that the two separate bones which in the swine connect the two large digits with the wrist or ankle are fused into a single cannon bone (Fig. 2); the primary dual origin of which is indicated by the two distinct pulley-like surfaces at the lower end, which carry the bones of the digits. The peculiar little ruminants known as the chevrotains—of which more anon—retain, however, evidences of their kinship with the swine, in that some of them have the two elements of the front cannon bone—or metacarpals as they are then called—quite separate from one another. Indeed, as indicated in the article last cited, in the same manner as we may trace a transition from the selenodont teeth of the ruminants to the bunodont ones of the swine, we may mark how the two-toed and cannon-boned ruminants passed into swine-like animals, with four toes supported by as many separate metacarpal bones.

Having now mentioned the leading characters of a modern ruminant, as distinct from other mammals, we may refer to a peculiarity which, although by no means characteristic of all, is a striking one, and one sharply differentiating the group from all others. This is the tendency to the development of appendages on the skull, arranged in a pair at right angles to its longer axis, and taking the form either of solid branching antlers, as in the deer, or of hollow sheaths of horn covering bony cores on the skull, as in the oxen and antelopes. The distinction between antlers and horns, having been described in an earlier article, need not further engage our attention.

Passing to the consideration of the various kinds of cud-chewing mammals, we find that the true ruminants, or those with hoofs, no upper front teeth, and a cannon bone in both limbs, arrange themselves in several minor groups. The most important to man are the "hollow-horned ruminants," such as oxen, sheep, goats, and antelopes, all of which are characterized by the presence of horns, at least in the males. The variety of form assumed by the horns renders this group one of the most attractive of all animals; and we have but to recall the curved and smooth horns of the oxen, the equally massive but wrinkled ones of the wild sheep, those of the ibex with their knotted points and scimitar-like backward sweep, the spear-like form of those of the gemsbok, and the spiral twist of those of the kudu and eland, to realize the variety of contour assumed by these appendages.

The oxen (including bison and buffaloes) are, with the exception of the American bison, Old World types, and were formerly abundant in Europe, where however they are now only represented by the bison preserved in the forests of Lithuania and the Caucasus, and by the half wild cattle (Fig. 3) of Chillingham and some other British parks, which have been thought to be the direct descendants of the British wild ox, or aurochs, of Cæsar's time, but are more probably derived from ancient domesticated breeds which have reverted to a nearly wild state. True wild oxen now exist only in India and the adjacent regions, while wild buffaloes occur both in India and Africa.

Equally characteristic of the Old World are wild sheep and goats, the "big-horn" being an outlying North American type. Both groups are essentially mountain animals, the headquarters of the former being the highlands of Central Asia, while on the southern flanks of the same mountain barrier the latter are more abundant. Both are also represented in the mountains of Europe; but in peninsular India there is but the wild goat of the Nilgerries, while in the whole of Africa we have only the wild sheep of Barbary and the ibex of Abyssinia. This absence of sheep and goats from Africa may, perhaps, be due to the fact that these animals are of comparatively late origin, and were probably poorly represented at the time when the other ruminants entered that continent from the north. The musk ox of Arctic America is an aberrant form allied to the sheep.

FIG. 4.—HORNS OF GAZELLE. (From Gunther.)

The antelopes have a distribution nearly the reverse of that of the sheep and goats, the great majority being restricted to Africa, where there are probably full ninety species, against about a score in all the rest of the world, except Arabia and Syria, of which the fauna is allied to that of Africa. Indeed, the only typical antelopes found beyond these regions are the black buck, the nilgai, the four-horned antelope of India, the saiga of Tartary, the chiru of Tibet, and several members of the widely distributed gazelles. The rings marking the horns of the latter (Fig. 4) and many other

FIG. 3.—THE WHITE CATTLE OF CHILLINGHAM PARK, NORTHUMBERLAND. (From Jardine.)

antelopes are very distinctive of the group, although by no means universal. The European chamois, the goat antelopes of India and China, and the Rocky Mountain goat of America, serve to connect the typical antelopes with the goats, and it is these alone which represent the group in Europe, to the eastward of India, and in North America. Seeing that in Tertiary times antelopes of African types occurred in Southern Europe and India, it is difficult to determine why the group should have so dwindled or disappeared there; although we can readily account for their extraordinary development when they once obtained an entry into Africa, on account of the immense area open to them, in which there was no competition by any other ruminants except buffaloes and giraffes.

To the zoologist, Africa is indeed a country characterized by the number of animals living there which have disappeared from other regions; and there is no better instance of this survival than the giraffe, a ruminant that, as regards its cranial appendages, stands midway between the hollow-horned group and the deer. We are all familiar with the ungainly and yet beautiful form of the giraffe; but it is probably less well-known that giraffes once roamed over Greece, Persia, India, and China, where, as in Africa at the present day, they were accompanied by ostriches and hippopotami. And here again we are confronted by the problem how to account for the disappearance from regions apparently exactly suited to their habits of all these animals. The giraffe is, however, not only the sole survivor of several extinct species of its own kind, but it likewise represents a lost group of Old World ruminants, intermediate between the horned and antlered types. The headquarters of this group was India, where, among other forms, occurs the gigantic sivathere, rivaling the elephant in bulk, and characterized by its two pairs of horns (Fig. 5), of which the

FIG. 5.—SKULL OF SIVATHERE, FROM THE PLIOCENE OF INDIA.

hindmost were branching and antler-like, although apparently never shed, and were probably covered during life with skin and hair.

If our attention has been turned to Africa as the headquarters of antelopes and giraffes, it must be directed to other regions when we come to the deer, since, with the exception of the Barbary stag, there is no representative of the group in all that continent. With few exceptions, deer are characterized by the antlers of the males, the reindeer alone having these appendages in both sexes. They are the only true ruminants found in South America, where most of the species have comparatively simple antlers, and thus show affinity with the early fossil types, some of which were antlerless. Allied species range through North America, but it is not till the north of that continent that we find in the wapiti a representative of our own red deer. The red deer group extends through Europe and a large part of Central Asia, but in India and the Malayan region it is replaced by the rusine deer, like the sambar, in which the antlers (Fig. 6 *a*)

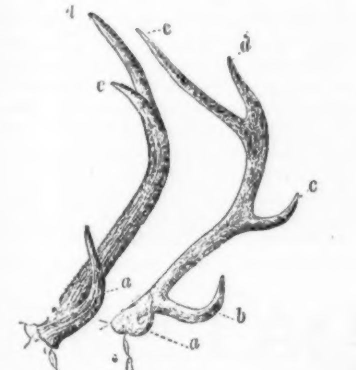


FIG. 6.—ANTLERS OF RED (A) AND SAMBAR (B) DEER.

a, brow; *b*, bez; *c*, trez-tine; *d e*, surroyals. (After Blanford.)

lack the bez-tine of the red deer (*ibid.*, *b*). Other marked varieties of antler are exhibited by the elk, the fallow deer, and the reindeer; but none of these approach those of the extinct Irish deer, which may have an eleven feet span from tip to tip. It is noteworthy that in a few small deer in which the males have no antlers they are compensated by having long tusks in the upper jaw.

The tiny Oriental chevrotains, and the larger African water chevrotain, form a group quite distinct from all the above, and are in some respects related to the swine. None of them have antlers, and the African species is the only living ruminant in which the two elements of the front cannon bone remain separate, thus affording another instance of the survival of primitive forms in Africa.

Lastly, we have the group of camels and llamas, which differ from other ruminants in that their feet form cushion-like pads, while their upper jaws possess front teeth. According to the latest researches, it is considered probable that this group has diverged from primitive swine-like animals quite independently of the true ruminants, an inference which, if confirmed, is very remarkable, showing that selenodont teeth, a complex stomach, the function of rumination, and the single cannon bone, have been acquired quite independently in the two groups. The present distribution of camels and llamas is remarkable, the former being confined to Africa and Asia, and the latter to South America. Here, however, geology comes to our aid, for in former times camel-like ruminants were abundant in North America, while the fossil camels of India show certain resemblances to the llamas, and we can thus understand how the present distribution of the two sections of the group has come about. With the possible exception of some herds of the Bactrian species in Central Asia, wild camels are now unknown, and we cannot even determine the original habitat of the single-humped species.

Thus ends our brief survey of the chief groups of living ruminants and their distribution. Did space permit, we might go on to refer to their extreme importance to man, both as sources of food and of clothing and as beasts of draught and burden, but having reached our limits, we trust that we may have aroused in our readers an interest in these highly specialized animals which may induce some of them to devote further consideration to the subject.—*Knowledge.*

THE OPTICAL CONSTRUCTION OF THE PHOTO-TELE-OBJECTIVE.*

AT a late meeting of the Amateur Photographic Club, in Vienna, Professor Anton M. Haschek exhibited a camera supplied with one of Dr. Adolf Miethe's photo-tele-objectives, giving a practical demonstration of the large image to be obtained with a minimum of camera extension.

On this occasion experiments were made by using a protractor as a model. The results demonstrated that at a distance of one meter, with six cm. camera extension, the resultant image on the ground glass equaled two-thirds the size of the subject.

With an ordinary lens, under similar conditions, the image measured but one centimeter.

At the next stated meeting Professor Haschek read a supplemental paper, in which he exemplified the optical construction of the new objective.

Professor Haschek stated that to be able to present a clear conception of its peculiar construction, it was necessary to refer cursorily to the primary principles of the lens theory as laid down by Gauss.

We will take for this purpose the figure of a cross section of a scalene bi-convex lens, showing the course of the parallel rays subsequent to their emergence from the lens.

We perceive here parallel rays which fall upon the lens from both sides, in direction of their axis. If we follow these rays, we find that those denominated 1, 2, 3, after their emergence from the lens are broken in their focal point toward F_1, while rays 1*, 2*, 3*, diverge toward F_2.

If we now lengthen the entering and emerging rays up to their diameter, we will find that rays 1, 2, 3 at the points *a*, *b*, *c*, and the rays 1*, 2*, 3*, at the points *a'*, *b'*, *c'*, intersect, and which, as will be seen by the drawing (Fig. 1), both rest upon a plane that inter-

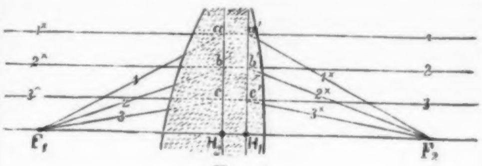


FIG. 1.

sects the axis of the points H_1 and H_2—a problem which is also capable of being demonstrated mathematically.

If we now resolve the whole proceeding into a problem as represented upon a corporal lens placed perpendicularly upon a level plane, the parallel planes become the principal plane of the lens.

We are now enabled to picture the process of refraction in a convex lens. When a ray parallel to its axis reaches the principal plane of a lens turned toward it, the ray penetrates without diversion, and breaks only when it reaches the next line of the principal plane. A ray becomes reversed when directed from its course toward the nearest principal plane, and parallel to its axis it takes its course through the focal point, and leaves the second principal plane without a change of direction.

You will thus perceive that the action of a lens is fully determined by four points, viz.: The focal points, F_1 and F_2, and the principal points, H_1 and H_2.

We will now apply this illustration to show the picture construction with a convex and concave lens.

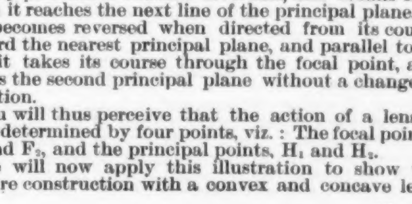


FIG. 2.

We will now take the four points, F_1, H_2, H_1, F_2, which will represent the cardinal points of a convex lens. The perpendicular lines, H_1 and H_2, represent the principal planes; "G," an object. To obtain our image, we draw a ray parallel to its axis, so that it penetrates the principal plane at H_1, and is released at H_2, through the focal point, F_1. The ray passing through the focal point at F_2 leaves the principal plane, H_1, parallel to its axis; the intersection of both rays gives the position of the arrow point in the picture. A perpendicular line drawn upon the axis designates the image, B, of the original.

When we connect the point, M, with H_1 and N with H_2, we find that the ray penetrating H emerges from H_2 in the same direction.

This property is utilized in the construction of a picture by aid of a concave lens.

Assuming once more an existence of the same conditions regarding the principal plane and focal points, the ray parallel to its axis intersects the principal plane, H_1, and is refracted at H_2, as if it emerged from F_2. The ray darting toward H_1 leaves H_2 parallel in an equal direction.

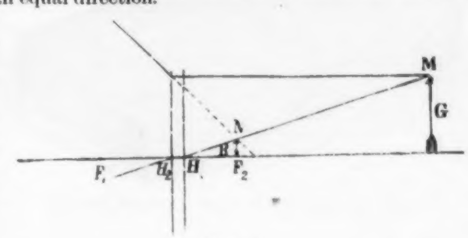


FIG. 3.

The intersection of both rays at N is an image of the point, M; the line, B, perpendicular to the axis is the image of the object, G. It will be observed that the intersecting point arises from the extension of the ray emerging from H_2, and that a virtual positive image results, in direct contrast to the convex lens, which gives a reversed image.

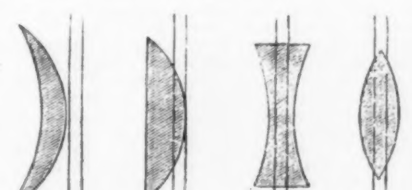


FIG. 4.

It is not requisite that the principal plane of a lens should fall within the body of the lens. By reference to above diagram it will be seen that the position of the principal plane varies with different lenses. Further, that in periscopic lenses the principal plane is actually outside of the lens.

Now, in relation to the new photo-tele-objective. The front combination consists of a convex lens, the back combination of a concave lens. It is requisite that the former combination should be of greater focal length than the latter. If both lenses are adjusted so that the separation is less than the difference in their focal length, it forms a combination well known to you in the opera glass. If, however, separated to a distance greater than their focal length, you have the tele-photo-objective.

You can easily judge of its action from the previous description of the lens theory, when you recall that the same conditions which are requisite in locating the principal plane in one lens answer for a system of refracting rays. When we follow a ray falling into the objective parallel to its axis, and intersect it with an emerging ray, we find the principal plane of the objective.

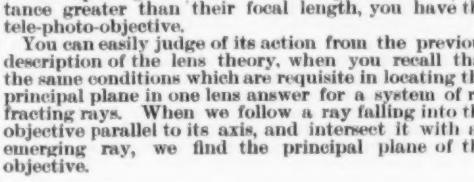


FIG. 5.

The ray refracted through the convex lens falls upon the concave lens, and in consequence the intersection with its axis is forced to the rear. As may be seen by the diagram, the previously mentioned intersection, together with the principal plane, is far in front of the objective.

As the distance of the focal point of the principal plane is at the same time the equivalent focal distance of the system, it proves that it is considerably greater than the vertical focal distance of the refracting plane from the focal points, and therein consists the action of the combination.

If we substitute for the place of the principal plane a convex lens of the same opening, and of equal focal point and principal plane, the action will explain itself. The illumination and size of image will be equal to this substituted lens.

It is hardly necessary to mention that the new objective is achromatic, and gives a flat picture. The learned professor further stated why the new objective would fail to fill the great expectations claimed for it.

To make an exposure upon an object at a great distance requires not so much an instrument like the one under discussion, but mainly an absolutely clear atmosphere, free from dust. It is this condition which will greatly circumscribe the uses of the new objective in the field for which it was designed. However, there may be other uses for which the combination may be utilized where it will render excellent services, not strictly of a telescopic character.

But, under all circumstances, the combination is a material advancement in modern optics, and the photographic public is greatly indebted to the inventor. JULIUS F. SACHSE.

* *Photographische Rundschau.* Translated and prepared for the *American Journal of Photography.*

ELECTRICAL CONDENSERS.

AN electrical condenser is a piece of apparatus that will accumulate an electric charge into a small space. We need not go into the history of the condenser, as these articles are designed to deal with facts; the practical condenser, therefore, is what concerns us now. Any one who cares to familiarize himself with the history of the condenser may do so at a trifling outlay for books.

The practical condenser is used very extensively in multiplex telegraphy and in submarine cable telegraphy. Although it may be constructed in different forms, the one used in this country is that shown in Fig. 1, which resembles an ordinary wooden box outwardly.

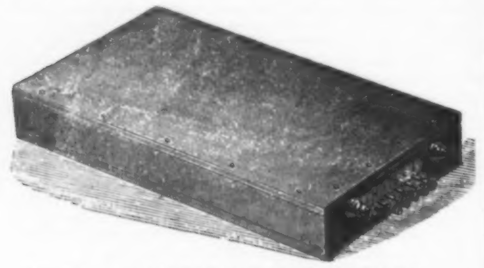


FIG. 1.—ADJUSTABLE CONDENSER.

The contents of the box, however, are the most interesting part, and these we will now consider.

Fig. 2 is a diagram which will aid the student in acquiring an idea as to how condensers are made.

The parallel horizontal lines represent sheets of tinfoil placed on top of one another, with some insulating material between.

Thin paper saturated with paraffine or thin sheets of mica are generally used for the insulation, the main object in the construction of condensers being to get the sheets of tin foil as close together and as well insulated from one another as possible.

It will be noticed that every alternate sheet is connected with the common terminals, as shown at the right and left hand ends of the illustration. By this arrangement a large positive surface is presented to an equally large negative surface of tin foil, and, according to the well known law of electric attraction and repulsion, a charge of electricity in a condenser will induce an equivalent charge of opposite sign in the opposite sheets of tin foil. If we connect one end of the condenser with one pole of a battery and the earth with the other pole of the battery, then connect the opposite end of the condenser directly with the earth, the condenser will become charged by induction, the charge from the battery inducing an opposite charge in the opposite plates of the condenser. In this condition a certain electric potential exists in the condenser, and if we discharge the condenser so charged through a proper measuring instrument, it is evident that we can tell thereby the value of the charge the condenser had. This in general is the way the "capacity" of condensers is measured.

The capacity of a condenser is the quantity of electricity it will receive to raise its potential to unity. The "farad" is the unit of condenser capacity; but as a condenser of such capacity would be entirely too large for practical use, the "microfarad" is adopted as the practical unit, and represents the millionth part of one farad.

In the telegraph duplex and quadruplex and other sensitive telegraphic apparatus the condenser is a very valuable adjunct. When a charge is sent to the line by the closing of the transmitting key, a return discharge takes place when the key is again opened. This discharge consists of the return of a portion of the current sent into the line by the closing of the key, and if the receiving instruments are of a sensitive nature, this return discharge is liable to affect them and cause what is technically called a "kick," which, in plain English, means that the magnets of the instrument become sufficiently charged by the return current to cause a false signal. False signals are very detrimental to the successful operation of a multiplex system of telegraphy, because it is absolutely necessary that the receiving instruments be entirely unaffected by the home signals, so that the signals from the distant end may be received unimpaired.

This "kicking" is counteracted by the use of condensers, which are properly connected with the instruments. The practical effect of a condenser here is to discharge its charge through the coils of the receiving instrument at the instant the discharge from the wire takes place. The effect of the latter discharge is thus neutralized, and the instrument practically remains unaffected.

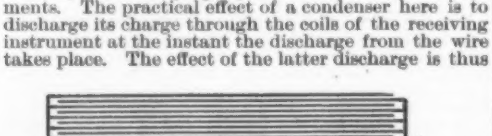


FIG. 2.—ARRANGEMENT OF SHEETS OF TIN FOIL.

As the return charge from the line varies with the atmospheric and other conditions along the line, it rarely remains constant for any length of time. To meet these variations adjustable condensers are used, so that their charge may be increased or decreased at will, in order to balance the discharge from the line.

The condenser illustrated in Fig. 1 is of the adjustable class. The tin foil plates are divided into groups, and the groups are cut out and in by means of the plugs shown at the right hand end of the illustration.

Submarine cables act as condensers of great length. The charge of electricity in the wire induces a charge on the outside of the insulation, which has a retarding effect on the working current. In order to overcome the effects of retardation, a charge from a condenser is sent into the cable immediately after each signal.

An Atlantic cable condenser is a huge affair. One was made by Messrs. Muirhead, of England, for duplexing one of the Atlantic cables, which contained a tin foil surface of over two acres, or 100,000 square feet. —*Electrical Age.*

SOME idea of the enormous cost at which large transatlantic mail steamers are equipped with the machinery requisite for their propulsion may be gathered from a few particulars as to one small item alone. The screw propellers in the Cunard steamships Umbria and Etruria are the largest yet fitted to any ship, each consisting of four blades of manganese bronze bolted to a cast steel boss. The diameter is 24 ft. 6 in., the pitch 33 ft. 6 in., the area of surface 216 square feet, and the total weight 39 tons; the weight of each blade being about seven tons. The cost of the manganese bronze as in the finished propeller runs about £120 per ton, the cost of the four blades being thus £3,360. The boss costs about £1,000 in addition, so that the total cost of only one of these huge propellers as fitted is but little under £5,000 or $25,000.

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